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ABSTRACT

The relationship between resources devoted to education and the economy of developing nations is explored. The research seeks to understand if and how investment in education translates into increased economic growth and labor productivity. Additionally, the function of education in reducing various dimensions of economic inequality is examined. The two East African nations that are the study's focus, Kenya and Tanzania, have similar levels of income, but they differ markedly in their public policy toward the provision of secondary education and thus in the educational attainment of the labor force. The research findings provide strong backing for the human capital paradigm: educational expansion is shown to raise labor productivity. The results also show that making education less scarce diminishes inequality in access to education and in income. Numerous figures and tables of data appear throughout this volume; a list of 170 references is included. (DB)

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EDUCATION, PRODUCTIVITY, AND INEQUALITY

John B. Knight
Richard H. Sabot

SO 030 340

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Education, Productivity, and Inequality

The East African Natural Experiment

John B. Knight
Richard H. Sabot

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Foreword

IN *Patterns of Development, 1950–1970* Moises Syrquin and I wrote, "In most developing countries the volume of resources devoted to education in the early 1950s was much below the optimum on almost any test. The period 1950–70 was one in which countries generally tried to catch up to some educational norm as rapidly as possible. Although the extent of this upward shift can be measured over the twenty-year period, there is no way to determine whether this adjustment process has run its course."

Since then educational expansion has continued, with the encouragement and assistance of the World Bank. Today developing countries spend more than $50,000 million a year on education. The normative question is now more pressing. Competition for scarce resources has increased, as has the academic controversy about the benefits from investment in education. Conventional cost-benefit assessments of these expenditures are open to ambiguous interpretation, are unable to refute theoretical challenges to the human capital paradigm, and ignore the distributional consequences of educational expansion.

In this book John Knight and Richard Sabot successfully employ an innovative approach to these issues. International comparisons such as those in *Patterns of Development* have established a relationship between educational enrollment ratios and per capita income. Knight and Sabot focus on two countries in East Africa with similar levels of income to isolate the consequences of different education policy regimes. Their design of rich and comparable macroeconomic data sets permits a more detailed quantitative analysis than is normally seen in international comparisons and a deeper examination of the consequences of educational expansion than can be obtained from conventional cost-benefit methods.

Knight and Sabot set out the competing hypotheses clearly, along with the means of testing them. Econometric modeling is thus used in a creative and convincing way. The authors deal with virtually every problem in human capital analysis and, moreover, are willing to consider institutional factors that are often ignored. They steer a fine course—acknowledging the uncertainties in the data and the constraints imposed by the modeling, yet coming to forceful conclusions. A comprehensive overview helps make the book accessible to the generalist as well as to the specialist.

Although the authors are properly cautious in assessing their results, their conclusions support the hopes of those who have placed their faith in educational investment. The findings provide strong backing for the human capital paradigm: educational expansion is shown to raise labor productivity. The results also show that making education less scarce diminishes inequality in access to education and in income. At the same time, the authors challenge some of the conventional wisdom regarding educational policy—for example, with respect to the relative returns to investment in primary and secondary education.

This pioneering book points the way for future work on the contribution of human capital to economic development and, more generally, on the "natural experiment" approach to economic comparisons.

Hollis Chenery
Harvard University

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Preface

THE SEARCH FOR UNIFORMITIES in the development process has been a prominent feature of research on the economics of development over the past fifty years. Clark (1940) and Kuznets (1966) were pioneers in this effort. More recently, Chenery and Syrquin (1975) provided a comprehensive description of the structural changes that accompany the growth of developing countries and analyzed their relations.

Chenery and Syrquin identify the accumulation of human capital as one of ten basic processes that appear to be essential features of economic development. A positive correlation between educational enrollment ratios and gross national product (GNP) per capita can be observed among countries at a given time and within countries over time. Such a correlation is consistent with the view that educational expansion is a cause of economic development, but it is also consistent with the reverse causation: the demand for education increases with income level. The average relationship between enrollments and GNP per capita is thus in itself a poor guide to policy.

Our research project was designed to address two underlying questions. To what degree is education an investment good that increases labor productivity and contributes to economic growth? To what extent does educational expansion yield the social advantage of reducing various dimensions of economic inequality? In pursuing these questions we chose to exploit the East African "natural experiment" in secondary education. Kenya and Tanzania are similar in GNP per capita and in many other relevant respects, but they have differed markedly in their public policy toward the provision of secondary education and thus in the educational attainment of the labor force. When the relationship between secondary enrollment and GNP per capita is graphed, Kenya is roughly at the level predicted for its income level, whereas Tanzania is well below the line.

We decided that progress toward answering our research questions could best be made by conducting large-scale sample surveys of the labor market to generate rigorously comparable microeconomic data sets in the two countries. The surveys were designed to investigate the consequences for the labor market of the contrasting education policy regimes and thereby to assess the efficacy of the policies. The decision to limit the scope of the inquiry to only two countries was influenced by the tradeoff noted by Chenery and Syrquin (1975, pp. 138–39): "Although disaggregation of comparative analysis involves some loss of generality because of the smaller number of countries having the required data .

. . more detailed hypotheses can be tested and the results are more useful in policy applications."

We have attempted to make our analysis both academically rigorous and relevant to policy and to make our results accessible not only to research economists but also to policymakers and readers with a general interest in these issues. This is reflected in the structure of the book. Part I provides a nontechnical overview of the project and a summary of its main findings. Parts II, III, IV, and V and the appendixes present the technical analysis. The general reader may confine himself to part I or may delve further into particular topics by reading selectively from other parts, whereas the specialist may wish to concentrate on particular areas. We have allowed for this by making each of the parts fairly self-contained at the cost of some repetition of basic background material. The more technical reader may also find the overview in part I to be useful as a means of orienting himself and of surveying the whole analysis, which is bigger than the sum of its parts.

This book is one of two studies emanating from the same research project and data sets. The other volume, *Education, Work, and Pay in East Africa* (by Arthur Hazlewood, Jane Armitage, Albert Berry, John Knight, and Richard Sabot, published by Clarendon Press) describes the economies and education systems of Kenya and Tanzania and contains an annotated set of cross-tabulations and other summary statistics based on the East African surveys. The intended readership of the two books is rather different. The companion volume to our study covers a broader range of topics and has considerably more descriptive material than our book. It will be of interest to policymakers, educationalists, and social scientists as a statistical source book of basic information that is, in general, not otherwise available. Although comparisons are made between the two countries in the introductory and concluding chapters, the statistical tabulations are presented separately for each country. This book, by contrast, is deliberately comparative throughout and concentrates on econometric analysis that abstracts from the basic data.

This project has been large and complex. The research was designed in 1979 and the fieldwork and data processing phase spanned much of 1980. Most of the analysis was conducted during 1981–84, and the time since then has been devoted, although less intensively, to writing up and disseminating the results. Over the years we have benefited from the help of many people and organizations, and our debt of gratitude is substantial. We are keenly aware of how many contributors from Africa, North America, and Great Britain—more than we can name individually—were essential to the success of the project, although they are free of responsibility for the opinions expressed here and for the remaining errors.

In the first place, we thank our patrons. Grants from the Research Committee of the World Bank funded the fieldwork and the initial analysis of the data, and the Development Research Department supported much of the subsequent work. Sabot was on the staff of the Development Research Department for much of the project, and Knight was a consultant. The Bank is uniquely able to identify important topics of research, gain the support of member countries for the implementation of research, and see that research findings are brought to bear on development policy. We are grateful to the Bank and in particular to Hollis Chenery, who with vision and organizational skill shaped the research staff of the Bank into the premier establishment of its kind and had the wisdom to allow a broad range of research initiatives to flourish. Gregory Ingram, Dean Jamison, Benjamin King, Timothy King, Ardy Stoutjesdijk, and Larry Westphal are other senior Bank researchers and research administrators who had an important influence on our inquiry. The logistic support provided by the Bank's resident mission staff, in particular Haly Goris in Nairobi and Anil Gore in Dar es Salaam, greatly facilitated the fieldwork.

Other bases for the researchers were the Institute of Economics and Statistics at the University of Oxford and, since September 1984, Williams College. Knight is a senior member of the institute staff, and Sabot is a former staff member and regular visitor. The intellectual contributions to the research made by various institute members proved invaluable, and we are also grateful for the institute's financial and logistic support. We should like to single out for thanks Teddy Jackson, David Hendry, and Stephen Nickell, successive directors of the institute. We are grateful to Knight's Oxford college, St. Edmund Hall, for granting the leave that made possible his full participation in the project. Williams College, where Sabot is currently professor of economics, offered an ideal intellectual environment in which to reflect on the technical analysis, draw out policy implications, and synthesize the results. We are grateful to Gordon Winston, Steven Lewis, and Michael McPherson, successive chairmen of the Economics Department at the college, and to others there.

In spring of 1983 the Rockefeller Foundation and the World Bank sponsored a conference on the findings of the project at the foundation's villa in Bellagio, Italy. The key participants were senior education policymakers from Kenya and Tanzania who agreed to meet and reflect together on the economic consequences of their policies toward secondary education although at the time their common border was officially closed and relations were strained. In some small way this interchange may have contributed to the changes in education policy since adopted by the Tanzanian government. We are grateful to the Rockefeller Foundation for hosting the conference and in particular thank Joyce Moock and Kirby Davidson of the Foundation staff.

Kenyan and Tanzanian policymakers are also to be thanked for their role four years earlier in obtaining government clearances and support for the project. The ministries of Finance and Planning in the two countries were the official backers of the project. We are grateful to Harris Mule, permanent secretary of the Kenyan ministry, and Ernest Mulokozi, principal secretary of the Tanzanian ministry, who were instrumental in obtaining the cooperation of government officials and of employers in the sample. Palmeet Singh, the director of the Central Bureau of Statistics in Kenya, and J. Mpogolo, his counterpart in Tanzania, kindly provided the sampling frames from which we drew our surveys. Others to whom we are indebted include, in Kenya, R. Kagia (National Examinations Council), J. K. Maitha (principal, Kenyatta College), Francis O. Masakhalia (permanent secretary, Ministry of Planning), J. Nkinyangi (Institute of Development Studies, University of Nairobi), L. T. Odero (permanent secretary, Ministry of Basic Education), and Tony Somerset (Ministry of Education), and in Tanzania, N. Kitomari (Ministry of Finance), R. M. Lingiwille (permanent secretary, Ministry of National Education), R. Mayaguila (Member of Parliament), Simon Mbilinyi (economic adviser to the president), G. V. Mmari (University of Dar es Salaam), Joseph Rugumyamhato (director of Manpower Planning), and S. Tunginie (principal secretary, Ministry of National Education).

The Institute of Development Studies of the University of Nairobi and the Economic Research Bureau of the University of Dar es Salaam helped with the selection of roughly twenty university students in each country as survey enumerators and provided facilities for training them and vehicles for transporting them to the firms at which the interviews were conducted. We are grateful to the late William Senga, director of the Institute of Development Studies, and to S. Mabele, director of the Economic Research Bureau. Our enumerators showed great commitment to the project and demonstrated an admirable combination of good humor, flexibility, willingness to work long hours—often under taxing conditions—and diplomatic skill. As is often the case with research involving fieldwork the enumerators, together with the 3,200 workers in our sample, who proved so responsive, are the unsung heroes of the project.

The Educational Testing Service of Princeton, N.J., gave advice on testing and prepared the special tests of cognitive skill that were so important to our research.

This project has been a team effort, and our research collaborators were crucial to its success. Arthur Hazlewood participated in the planning of the project and in each of our visits to the field. His work on the companion volume, of which he is the principal author, constantly informed and enriched our inquiry. While serving as our research assistants Jane Armitage and Maurice Boissiere wrote their doctoral dissertations at MIT and Joy de Beyer wrote hers at Oxford. We worked closely with them on their analysis, the results of which are imbedded in several of the chapters that follow. The rapport of the core team not only increased our productivity but also made the work a pleasure. It is difficult to imagine producing this book without our collaborators.

At times the team expanded to include other senior and junior members. Albert Berry helped administer the Tanzania survey and contributed material to the companion volume. Paul Collier helped administer the Kenya survey and wrote a background paper on developments in the markets for education and labor in East Africa. Arne Bigsten also participated in the administration of the Kenya survey. We turned frequently to Jere Behrman for technical advice and were coauthors of a methodological paper with him. David Lindauer was coauthor of a background paper on the public-private wage differential in Tanzania. Alex Bowen provided helpful research assistance. Others from whom we received valuable comments and advice include Nancy Birdsall, Mary Jean Bowman, Jerry Hausman, Laurence Lau, Jack Maas, David Newbery, Sherman Robinson, and Nicholas Stern. The book also benefited from comments by participants in seminars at over a dozen academic institutions at which we presented preliminary results and by editors and referees of journals in which we published material from the book. Maria Ameal of the World Bank's Development Research Department and Caroline Baldwin, Gillian Coates, and Nicola Ralph of the Oxford Institute efficiently and cheerfully shouldered much of the secretarial burden imposed by the project. Bruce Ross-Larson provided a light editorial touch in the early stages.

Thanks are due to the editors of the following journals for permission to use material first published in them: *American Economic Review*, *Economica*, *Economic Journal*, *Economics of Education Review*, *Journal of Development Economics*, *Oxford Bulletin of Economics and Statistics*, and *Oxford Economic Papers*. Specific references are given for each chapter that contains such material.

Despite our best efforts, we have honored Horace's dictum: "Let your literary compositions be kept from the public eye for nine years at least" (*Ars Poetica*). Our greatest debt of gratitude throughout the period is to Janet and to Jude for their encouragement and support, without which the book would have taken still longer to complete. To them it is dedicated.

Part I

INTRODUCTION AND OVERVIEW

CHAPTER 1

The Issues, the East African Natural Experiment, and the Surveys

AS AN ECONOMY DEVELOPS, the educational system normally expands. What effect does this expansion have on productivity and on the growth and distribution of income? The experience of Kenya and Tanzania may illuminate this question. These two countries, with their similar histories and economic conditions but markedly divergent education policies, constitute a "natural experiment" in which most of the relevant variables are as controlled as is possible in a real-life situation while the variable of interest differs. Study of the consequences of these two approaches to education in East Africa offers an opportunity to test plausible hypotheses about the benefits of education and related issues.

The Issues

A positive correlation between school enrollment ratios and per capita output has been observed in different countries and within the same country over time. But correlation does not establish causation. Is education primarily an investment good that increases labor productivity and contributes to economic growth? Or is it a consumer good that is increasingly demanded as incomes rise? The answer is important for government policies regarding public and private spending on education.

On average, governments in developing countries spend about 3 percent of gross national product (GNP) on education, and it has generally been their policy to increase this proportion. This can be seen in table 1-1, which also shows the rise in enrollment ratios over two decades. Although these trends can often be explained by government response to rent-seeking pressures for subsidized education, the usual case made for subsidies is that the social returns to education are greater than the private returns or that private demand is constrained by imperfections in the capital market. The issue of subsidies to education is now more press-

Table 1-1. *Educational Expansion in Developing Countries*

	Low-income countries		*Middle-income countries*		
Item	*All*	*Excluding China and India*	*All*	*Lower-middle*	*Upper-middle*
Number of countries	34	32	60	39	104
Central government expenditures on education per capita (1975 dollars)					
1972	3	3	20	15	25
1980	6	3	27	16	42
Central government expenditures on education (percentage of GNP*)*					
1980	3.0	1.1	2.9	3.4	2.6
Primary enrollment (percent)					
1960	80	37	75	66	88
1980	93	70	100	98	104
Secondary enrollment (percent)					
1960	18	6	14	10	20
1980	29	19	39	33	48
Tertiary enrollment (percent)					
1960	2	1	3	3	4
1980	4	2	11	10	13

Source: World Bank (1983), tables 25 and 26.

ing than it was two or three decades ago, when subsidy programs were small or were just being introduced. Slower economic growth and tighter budgetary constraints in the 1980s mean that spending on education faces greater competition from other claims, and the rationale for subsidies faces renewed scrutiny.

Labor Productivity

The empirical evidence for the propositions that education raises productivity and that more resources should be diverted to education comes from accounting exercises and rate of return studies. Crude output accounting exercises have suggested that more than half of the difference in income per capita between high- and low-income countries is attributable to differences in endowments of human capital (see, for instance, Krueger 1968). A survey of rate of return estimates in forty-four countries has found that social rates of return to education are generally competitive with returns to investment in physical capital (Psacharopoulos 1981).

Are such estimates, made with the use of the standard methodology, sound guides for the allocation of public resources? An underlying assumption of the standard methodology is that differences in wages among workers of different educational levels measure the effect on workers' productivity of human capital acquired in school (the human capital hypothesis). Thus a large wage premium for better-educated workers indicates that the social rate of return to education is high. But it can also be argued that the premium on education measures the effect on productivity of native ability or motivation—an effect that schools pick out but do not augment (the screening hypothesis). Still another explanation (the credentialist hypothesis) is that the educational structure of wages is institutionally determined and that the better educated earn more because of their higher credentials. These criticisms imply that, although the private return to education may indeed be high, the standard estimates of the social return on investment in education and of the contribution of education to growth are biased upward. In subsequent chapters we examine these issues with the help of new data and methods.

Income Distribution

Government subsidization of education has also been defended on the grounds that educational expansion, by making human capital more abundant, will reduce inequality in the distribution of pay. Perhaps three-quarters of the inequality of income in industrial countries can be explained by the inequality of earnings from employment (Blinder 1974; Phelps Brown 1977). In developing countries the contribution of inequality of pay to total inequality is smaller, but inequality of pay is greater and its contribution to total inequality is increasing as wage employment grows.

Simple two-sector models have been widely used to explain the well-known tendency for the inequality of income first to increase and later to decrease as economic development takes place (Kuznets 1955; Robinson 1976). The transfer of workers from a large low-income sector to a small high-income sector is likely to increase inequality, which declines only when the proportion of workers in the high-income sector reaches a minimum size. This notion can also be applied to educational groups in the wage labor market. The expansion of the educated group increases the proportion of educated in relation to uneducated workers, and this composition effect is likely to increase inequality at first. But a countervailing compression effect tends to reduce inequality. Educational expansion has been seen to compress the educational structure of pay in industrial countries over the decades (Phelps Brown 1977, pp. 81–89) and has been singled out as an important policy tool for narrowing pay differentials (Lydall 1968, pp. 254–66). In many developing countries the supply of educated workers is growing faster in relation to wage employment opportunities than in the industrial countries. This suggests that the compression effect could outweigh the composition effect.

The compression effect relies on the operation of market forces. Whether labor markets in developing countries can adjust the educational structure of pay to large and rapid increases in the supply of educated workers is a matter of concern. In most developing economies the public sector accounts for a much larger share of wage employment than in the industrial market economies; often more than half of all wage earners work for the government and for parastatal bodies. The dominance of the public sector, particularly in the market for educated labor, means that it need not act as a price taker. Indeed, public sector wages are often influenced by bureaucratic or political considerations—the former associated with internal labor markets and the latter with distributional, fiscal, and employment goals. Thus the educational structure of pay in the public sector may be unresponsive to market forces, and rapid educational expansion, instead of compressing wages, may increase unemployment among the educated. In our discussion of the effects of educational expansion on the inequality of pay, we distinguish composition and compression effects and the influences exercised by market and nonmarket forces.

Intergenerational Inequality

Education policy is relevant to another dimension of inequality—the distribution of income among families from one generation to the next. One rationale for subsidizing education is the belief that the ability to pay school fees should not determine the distribution of school places. Because parents who are well educated and have high incomes are better able to afford school fees or to finance them from savings or by borrowing, access to education in an unsubsidized system tends to be biased in favor of their children, and socioeconomic status may be perpetuated over generations. Many studies have found differences in educational attainment according to socioeconomic background; see, for instance, Coleman and others (1966) and OECD (1971) for developed countries and Behrman and Wolfe (1984a, 1984b) and Birdsall (1985) for less developed countries.

Equality of educational opportunity, which is commonly regarded as the hallmark of a just society, can be justified on grounds of equity. It can also be justified on grounds of efficiency, on the premise that more able workers can use their schooling more productively. But a combination of subsidies and meritocratic selection criteria may not be enough to ensure equality of educational opportunity. Higher-quality preparatory schooling, better training in the home, or other advantages may enable a disproportionate number of children from families of high socioeconomic status to satisfy meritocratic selection criteria. In that case, unequal access to education will persist, and those best able to meet the costs of their children's schooling will benefit disproportionately from the subsidies.

Subsidization of education can also promote equality in the distribution of school places by increasing demand and, if the higher demand can be effectively translated into pressures for greater public provision, generating educational expansion. If most children from high socioeconomic backgrounds gain access when the system is small, expansion may disproportionately increase the access of children from less privileged backgrounds. And yet it may do little to increase intergenerational mobility, measured in a relative sense. Children from privileged backgrounds can protect their status by taking their education a stage further. And among workers with the same educational attainment, those with superior socioeconomic backgrounds may continue to be more successful in the labor market as a result of discrimination or of differences in productivity that stem from better schooling or better training in the home. Our data permit us to explore the effects of educational expansion on the intergenerational dimension of inequality, a topic little studied by economists.

Research Design: The Natural Experiment

In experiments in the natural sciences, particular causal factors are varied in a controlled way while other exogenous factors are held constant, and the effects are then studied. The best equivalent experiment that can be done in the social sciences is to seek out and compare situations in which the factors under study vary while other conditions remain roughly the same. Where the causal factor of interest is economywide, as in the case of the relative abundance of human capital, the situations to be compared should represent either different periods or different countries. For instance, a comparison might be made within a country before and after a rapid expansion of education or between two countries with different relative stocks of educated labor. In either case the economies to be compared should be as similar as possible in all other relevant respects.

A study of this kind constitutes a *natural* experiment because, in contrast to controlled experiments in the physical sciences, the situations being observed are the outcomes of interactions among economic agents, including government, and are beyond the researcher's control. It can be termed an *experiment,* as distinguished from a conventional econometric analysis, because there are too few observations to permit the isolation of the influence of each variable by statistical means. Economists frequently use natural experiments as a method of argument, but usually in an informal way. Among the more systematic cross-country studies are Chenery and Syrquin (1975) on patterns of development and Little, Scitovsky, and Scott (1970) on industrialization policies. The methodology, however, is rarely developed with the precision that we have attempted in the research described in this book.

Kenya and Tanzania provide a natural experiment in secondary education. The two countries are similar in size, colonial heritage, resource endowment, structure of production and employment, and level of development, and their urban wage economies do not differ greatly in technical conditions or in the intensity of physical capital. Both countries achieved independence in the early 1960s and inherited administratively similar but undeveloped education systems and negligible stocks of indigenous educated manpower. Today they differ markedly in one dimension of the supply of educated manpower: secondary schooling. It is on this difference that our analysis focuses. Dissimilarities in the extent of government intervention in the economy, especially in government pay policies, have a bearing on our inquiry, but we were able to standardize for this difference.

In both Kenya and Tanzania primary education comprises seven years of schooling (standards 1–7) and lower secondary education four years (forms 1–4). The two years of the much smaller upper secondary system (forms 5–6) are followed by various types of tertiary education. Unless otherwise indicated, secondary education means lower secondary.

Primary education in both countries is nearly universal, and tertiary enrollments are less than 1 percent of the relevant age group. But in Kenya, which has a slightly smaller population than does Tanzania, the secondary enrollment ratio was 18 percent in 1980, and in Tanzania it was 4 percent (World Bank 1983, table 25). Although Kenya's population was about 15.9 million in mid-1980 and Tanzania's was about 18.7 million (World Bank 1982, table 1), students in lower secondary school numbered 410,000 in Kenya but only 67,000 in Tanzania. Kenya's secondary enrollment ratio is roughly at the level predicted by a cross-country comparison for countries with its national income per capita, whereas Tanzania's ratio is well below the predicted level.

This difference in secondary enrollments is attributable largely to differences in public policy regarding secondary education rather than to differences in private demand. In both countries the government has satisfied only a small part of the demand for places at government secondary schools. Places are accordingly rationed on meritocratic criteria, principally performance in the nationwide primary-leaving examination. Government secondary schools are highly subsidized in both countries, and the rationing is partly a result of budgetary constraints. In addition, both governments paid heed to early manpower planning exercises which suggested that the private demand for government school places, inflated as it is by the subsidies, is a poor guide to the socially optimal supply of secondary completers. East African manpower planners have repeatedly warned that the consequences of too rapid an expansion of the secondary system would be a supply of overqualified workers, unemployment of the educated, and a waste of scarce resources.

In Kenya, between 1963, the year of independence, and 1980, the year of our survey, secondary enrollment increased by 17 percent a year, from a mere 30,000 to 410,000. In 1980, 43 percent of enrollment was in maintained and assisted (that is, government) schools, 20 percent was in assisted harambee (self-help) schools, and 37 percent was in unassisted harambee and private schools. ("Harambee" is Kiswahili for "let's pull together.") The proportion of funding from public sources was 53 percent in the government schools, 18 percent in the assisted harambee schools, and 0 in the remainder; the overall weighted share of public funding was 25 percent (Wolff 1984, table 6). The government, expressing concern about both costs and the "school leaver problem," attempted to restrict the growth of enrollment in government secondary schools, particularly after 1974 (Kenya, Ministry of Economic Planning 1974, pp. 404–05). Harambee and private schools responded to the demand for secondary schooling by Kenyan children who were unable to get into government schools but were able to pay the higher fees, and enrollment in these schools grew rapidly. Moreover, the burgeoning harambee movement had implications for the government sector. In response to political pressures, the government took over some harambee schools and partly subsidized some others.

Between 1963 and 1980 secondary enrollment in Tanzania grew by 8 percent a year—from only 17,000 to 67,000 (Cooksey and Ishumi 1986, table 2.4). In 1980, 58 percent of secondary students were in government schools. Tanzania had few community schools corresponding to the harambee system in Kenya. Public finance represented 86 percent of the total cost of attending government secondary school, and there was no subsidy in private schools (Wolff 1984, table 6). The share of government finance overall was 50 percent. Enrollment in government schools increased by only 20,000 between 1963 and 1980 and stagnated entirely in the last five years of the period, partly because of budgetary constraints, which were particularly tight after the decision in 1974 to move rapidly to universal primary education. Of no less importance, however, was the influence of manpower planning. The government accepted the proposition that postprimary education should not be expanded beyond the "requirements" of the economy as gauged by existing input-output relationships. It also constrained the growth of the private secondary system, first by prohibiting private schools (none existed until 1965) and then by imposing highly restrictive regulations on their establishment and operation. The government appeared to be concerned not only about the possibility of wasteful "overproduction" but also about the maintenance of educational standards and about the distributional implications of a system that catered to those who could afford to pay for education. Despite these constraints, the private sector responded to the demands of those unable to enter government schools and grew beyond the limits recommended by the manpower planners. In contrast to the situation in Kenya, however, the private market for secondary education in Tanzania remained in disequilibrium.

Policies on secondary education have thus diverged sharply in the two countries in regard both to the highly subsidized government schools (Kenya provides 4.6 places for every 1 in Tanzania) and to private schools (Kenya permits 8.3 times as many places). In 1980 Kenya's secondary enrollment was 6.1 times that of Tanzania. By that year the diverging education policies had brought about an important difference in the educational composition of the two countries' urban wage labor forces. This natural experiment provided an opportunity for answering some important questions. By examining the markets for labor and education, we were able to estimate the effects of the divergence on income and its distribution and to evaluate the relative merits of Kenya's more responsive and expansionary secondary education policy and Tanzania's more interventionist and restrictive policy.

The Surveys

A single cross-section cannot be used to analyze the effect of a change in factor endowments. To conduct a comparative static analysis, at least two cross-sections are needed. Comparisons over time require observations that are several years apart. This could be achieved through a single survey that generates retrospective data, but such data generally suffer from biases in sample selection and from problems of respondent recall. The remaining practical course is to analyze cross-sections from two or more countries that differ in the factor to be studied.

To exploit the possibilities offered by the natural experiment in Kenya and Tanzania, we had to generate new data. Those data had to be rigorously comparable; any possibility that an observed difference in behavior might be in part attributable to differences in sample design or in definitions of variables could cast doubt on the validity of the comparisons. Although existing sets of microeconomic data could shed some light on the issues we wished to explore, no two were rigorously comparable, and none was specifically designed for the purpose. Our surveys contain many measures of respondent characteristics that are not available elsewhere—at all or in sufficiently disaggregated form—or that are not available in the same data set with other variables essential to the analysis. The following examples illustrate the uses that can be made of our specially constructed data sets.

- Our measures of respondents' reasoning ability and cognitive skill provided the basis for a simple recursive model of educational attainment, cognitive skill, and earnings. This model allowed us to evaluate the human capital, screening, and credentialist interpretations of the link between educational attainment and earnings. It also provided a basis for assessing, by means of output accounting, to what extent the differences in labor productivity between Kenya and Tanzania can be attributed to differences in their education policy regimes.
- Our skill-based occupational classification of respondents and our other measures of the characteristics of respondents and their employers enabled us to examine the detailed structure of wages in the public and private sectors. Simulations of these structures were then used to assess how much of the difference between Kenya and Tanzania in the wage premium to secondary education was attributable to differences in relative demand for secondary completers, how much to differences in public sector pay policy, and how much to the greater supply of secondary completers in Kenya.
- The educational history and family background of each respondent made possible a comparative cost-benefit analysis of investment in private and government secondary schools. This analysis allowed us to assess the consequences for efficiency and equity of government subsidies to secondary education.

Design

In designing the surveys we decided that the comparison of Kenya and Tanzania should focus on the stock of economically active secondary graduates. Because in both countries this stock is concentrated in the urban wage sector, we chose to conduct establishment surveys of urban wage employees rather than household surveys. Several related factors reinforced this decision. Much of the analysis pertains to behavior at the workplace, and data on such behavior are best collected there; they are likely to be more accurate than similar data from household surveys because confirmatory information can be (and was) obtained from the employer. Moreover, secondary completers are a much higher proportion of wage employees than of the urban population. The sample for an urban household survey would therefore have to be many times larger than that for an establishment survey to obtain an equally large sample of employees with secondary education. For this reason and because of the greater geographic dispersion of respondents and the lack of readily available sampling frames, a household survey would cost much more than an establishment survey.

The disadvantage of an establishment survey is that it is not comprehensive. Our sample represented the urban wage labor force and the great majority of secondary completers, but it did not include unemployed or self-employed secondary completers. It was therefore not possible to analyze the effect of educational expansion on unemployment, on participation and earnings in self-employment, and on labor force participation. These issues, although of interest in East Africa, are of relatively low priority. Other sources indicate that the labor force participation rates of secondary completers are very high in East Africa and that their unemployment and self-employment rates are very low.

Sample selection bias poses a potential problem for any survey of urban wage labor. For instance, if the urban wage labor force, and therefore our sample, is selective of the most accomplished secondary completers, estimates of the effect of secondary schooling on productivity may be biased upward. But because such a low proportion of primary completers gains access to urban wage employment, selectivity among primary completers is likely to be greater than among secondary completers. Since our assessment of productivity benefits stems from a comparison of the relative performance of these groups, any net bias is likely to be downward. The effect of such bias is to strengthen our conclusions.

The positive link between family background and educational attainment is at the core of our analysis of the effects of educational expansion on educational access and intergenerational mobility. Such a relationship could be biased upward because the mean level of educational attainment in our sample of urban wage employees is higher than the educational attainment of the labor force as a whole. But because the uneducated children of the uneducated are underrepresented in our sample, the estimate of that relationship is likely to be biased downward, strengthening our argument. More generally, it turns out that the sample selection bias inherent in our surveys does not pose serious problems of interpretation.

In sum, if a household survey were to be comprehensive, it would have to be representative of the entire population of the country, both urban and rural. Such a survey would be prone to greater errors in the measurement of key variables and would cost much more than an urban establishment survey. Given the aims of our analysis and the conditions in East Africa, the incremental benefits of the larger undertaking would have been small. The expected net returns to an urban establishment survey therefore far exceeded those to an urban or national household survey.

Administration

The respondents in the surveys of wage employment and education in Kenya and Tanzania were randomly selected from the wage labor forces in Nairobi and Dar es Salaam. Previous labor market survey work had suggested that capital cities were not unrepresentative of urban areas in respect to relevant wage-employment characteristics. (See Sabot 1979, which compared Dar es Salaam with other towns in Tanzania.)

A sample of establishments stratified by size and sector was randomly drawn from a frame provided by the central statistical bureau in each country. In each establishment a random sample of employees was drawn from a complete list of employees provided by the employer. The result was a representative sample of urban wage employees containing nearly 2,000 respondents in each country.

Teams of university students, trained and supervised by the authors and other researchers, administered the questionnaires and tests to the respondents in 1980. The questionnaires covered respondents' demographic characteristics and family background, education and training histories, current and previous earnings, experience in current and previous jobs, links with rural areas, and own children's education. Reasoning ability was assessed with Raven's Coloured Progressive Matrices. This test, which is widely used in developing countries, asks the respondent to match pictorial patterns, a task in which literacy and numeracy confer no advantage. The tests of literacy and numeracy were designed for the surveys by the Educational Testing Service, Princeton, N.J., on the basis of the national school-leaving examinations, both primary and secondary, and other guides to the content of the academic curriculum. The curriculum is much the same in Kenya and Tanzania, except that Kiswahili is stressed more in Tanzania. Questions were given in both English and Kiswahili so that respondents could choose the language they preferred. The sum of the scores on the literacy and numeracy tests was used as the measure of cognitive skill.

Two other features of the sample should be noted. First, in both countries respondents were from all sectors of the urban wage economy—manufacturing, services, and commerce—but a disproportionate number was employed in manufacturing. This oversampling, which in the aggregate analysis was adjusted with appropriate weights, permitted detailed comparisons of the manufacturing sector subsamples of the 1980 surveys with a similar survey of wage employees in manufacturing that Sabot had conducted in Dar es Salaam in 1971 (Sabot 1979, p. 251). These comparisons add an intertemporal dimension to the cross-country analysis of educational expansion. Second, the questionnaires were administered to all respondents, but only a stratified subsample of respondents was given the tests of reasoning ability and cognitive skill. The subsamples for each country consisted of about 200 respondents who had left formal education after exactly completing primary school (standard 7 or 8) or secondary school (form 4).[1] The cost of administering the test was high, as was the risk that the expected benefits from this feature of the surveys would not justify the cost. Hindsight shows that the added benefit of increasing the size of the subsamples would have outweighed the cost.

Note

1. Standard 7 is now the final year of primary school; before 1966 it was standard 8.

CHAPTER 2

Overview: Findings and Implications for Policy

THIS CHAPTER OFFERS an overview that provides the reader with a coherent perspective on the study as a whole. Succeeding chapters make frequent use of the same data sets to consider specific questions, each of which requires a separate technical analysis. But the whole is bigger than the sum of the interrelated parts, and it would be difficult for readers to see the wood if they were taken immediately to inspect each tree in turn. This chapter therefore summarizes arguments and findings without much reference to sources, methods, and data, which are fully provided in the detailed analyses. Part I can stand by itself and may suffice for readers who are not interested in the analysis and methodology. We hope, however, that most readers are unwilling to take our interpretations and conclusions on trust and are curious to know how we reached them. For these readers the overview is intended to whet the appetite for the main course to come.

Parts II, III, and IV of the book examine, in order, the three issues introduced in chapter 1—the relationships between the expansion of secondary education, on the one hand, and labor productivity, income distribution, and intergenerational mobility, on the other. Part V examines methodological and policy issues in the cost-benefit analysis and in the financing of secondary education. Part VI considers the implications of the findings for future research and the extent to which our East African results can be generalized to other countries and situations. The appendixes provide details concerning the research instruments and methods.

Educational Expansion and Labor Productivity

Does educational expansion yield social benefits in the form of increased production, or are the benefits only private and redistributive? We examine this question by considering first the similarities between the two countries and then the differences that arise from the natural experiment.

The Alternative Hypotheses

In cost-benefit analyses of education, the relationship between wages and years of education is used to measure the social benefit of education. The assumption is that the education-wage relationship measures the effect on labor productivity of human capital acquired in school (the human capital hypothesis). For this to be true, however, neither ability nor years of schooling should have an independent influence on wages. These factors must influence earnings only indirectly, by raising the level of skills acquired in school: they must work through the educational attainment function and the educational production function, which summarize in general terms the relationships between the inputs and outputs of the education system.

The screening hypothesis predicts that the influence of ability on productivity will be large in relation to the influence of skills acquired in school. Taken to its extreme, the hypothesis posits that schools simply identify the potentially more productive and do not increase the productive capacity of students. Educational attainment—as measured by years of schooling—"signals" workers with more ability and, because ability raises productivity, is rewarded with higher earnings.

The loose amalgam of hypotheses generally known as credentialism is a more radical rejection of the human capital interpretation of the education-wage link. According to this view schools provide students with a credential that is personally valuable but not productive. Educational qualifications are rewarded irrespective of their economic value. For instance, a government may determine wages and establish education-based hiring and payment criteria, or private employers may discriminate in favor of the educated because they share similar socioeconomic backgrounds. The implication is that the education-wage link is not a proxy for the effects on labor productivity of skills acquired in school or of ability but is a measure of the independent effect of years of schooling on earnings.

Conventional measures of the social benefit of education and the contribution of education to economic growth may be biased upward if the screening or credentialist interpretations contain some truth. Our means of adjudicating among the hypotheses is to measure all the relevant relationships, not just the education-wage relationship, and our data sets were designed to make this possible. The econometric analysis reported in chapter 3 involves the estimation of educational attainment functions (which measure the effect of ability on educational attainment), educational production functions (which measure the effects of ability and years of education on human capital acquired in school), and expanded human-capital wage functions (which measure the effects of ability, human capital, and years of education on earnings).

Cognitive Skill and the Educational Structure of Wages

Our measure of human capital acquired in school is the cognitive skill score. The wage functions allowed us to weigh the relative direct influences of reasoning ability, years of schooling, and cognitive skill (our measure of human capital acquired in school—also termed achievement) on the structure and variance of earnings. The results show that whereas the direct returns to reasoning ability in the labor market are small and the returns to years of schooling are moderate, the returns to cognitive achievement are large. They are not significantly lower among manual than among nonmanual workers or among primary than among secondary completers. Presumably this is so because literacy and numeracy increase the productivity of all types of workers, manual as well as nonmanual.

To illustrate these results, simulations were conducted with the estimated wage functions. One such simulation shows that differences in reasoning ability account for little of the large gap in mean wages between primary and secondary completers. The direct returns to ability in the labor market are so low that giving primary completers the ability levels of secondary completers while keeping their cognitive skill levels constant would increase their earnings by less than 7 percent in Kenya and by less than 4 percent in Tanzania. Giving primary completers four more years of schooling (without altering their ability or achievement) would increase their earnings by 19 percent in Kenya and by 13 percent in Tanzania. Differences in cognitive achievement between primary and secondary completers account for the largest proportion of the wage gap. Giving primary completers the cognitive skill of secondary completers (without altering their other characteristics) would increase their earnings by 25 percent in Kenya and by 15 percent in Tanzania.

There is much variation in cognitive skill and in reasoning ability within the two educational groups. Among Kenyan primary completers the score of the bottom 10 percent on our test of reasoning ability is 11 out of a possible 36, while that of the top 10 percent is 34. The range of cognitive skill is from 13 out of a possible 63 for the bottom 10 percent to 52 for the top 10 percent. Among Kenyan secondary completers the corresponding ranges are 17 to 35 on the ability test and 28 to 56 on the cognitive skill tests. In Tanzania the ranges are similarly broad. Moreover, in both countries the reasoning ability and cognitive skill distributions of primary and secondary completers overlap considerably.

A second set of simulations indicates that the predicted earnings of primary completers of high ability are less than the predicted earnings of less able secondary completers. In neither country is being among the brightest of one's peers a sufficient condition for successful performance in the labor market. The results of a similar simulation with cognitive skill are quite different; in each educational group high achievers earn much more than low achievers, and the predicted wage of primary completers who scored in the top third is nearly as high as that of secondary completers who scored in the bottom third. In both countries, it would seem, how much one learns in primary or secondary school has a substantial influence on performance at work.

Cognitive Skill and the Returns to Employment Experience

A strong relationship between earnings and employment experience is almost universal and is normally explained as the result of on-the-job acquisition of skills. Kenya and Tanzania follow this rule: in both countries earnings rise steeply with employment experience. When other characteristics are standardized, a worker with ten years of experience is found to earn a premium in relation to a labor market entrant of 57 percent in Kenya and 56 percent in Tanzania.

Our interest is in the relationship between educational attainment (years of education) and the returns to employment experience. In poor and rich countries alike, it is generally found that the higher is the level of education, the more rapidly do earnings rise with experience. This pattern holds in Kenya and Tanzania. The growth rate of earnings per year of employment experience is roughly 2 percent greater among secondary than among primary completers in Kenya and 1.5 percent greater in Tanzania. This is relevant to education policy because the difference in the present value of the lifetime earnings streams of primary and secondary completers is conventionally taken as a measure of the gross social benefits from investment in secondary schooling. The higher returns to experience of secondary completers account for roughly 90 percent of this difference in Kenya and for more than 100 percent in Tanzania.

The explanation offered by human capital theory for this positive interaction is that investments in schooling and in postschool training are complementary. The more education workers have received, the greater is their cognitive skill. The more cognitive skill they have acquired, the more vocational skills they will acquire over their working lives, both because they are likely to devote more time to training and because their higher level of cognitive skill permits them to derive more from training. The greater the accumulation of vocational skills, the steeper is the earnings-experience profile.

According to proponents of screening theory, the link between investments in schooling and in vocational training is simply that both are related to ability. The credentialist explanation would be that the educated have higher returns to experience because they are more likely to have white-collar jobs in which earnings rise with tenure irrespective of any increases in skills and productivity. Thus, how much of the private benefits of investment in secondary schooling should be included among the social benefits will depend on the choice of interpretation.

Our expanded human capital earnings functions permit a simple test of these competing explanations, as discussed in detail in chapter 4. The human capital explanation predicts that the returns to experience will be higher for workers with higher cognitive skill, even among those with the same education. Furthermore, it implies that the higher returns to experience of secondary completers are attributable to their higher cognitive achievement. The predictions yielded by the credentialist explanation are different. Because the returns to experience are tied to educational credentials by institutionally determined wage structures, secondary completers have the same returns to experience irrespective of their level of cognitive skill. Since the same is held to be true of primary completers, the difference in cognitive skill between the two educational groups cannot be responsible for their difference in returns to experience. We therefore test the hypotheses by asking two questions. First, is there a positive relationship between cognitive skill and the returns to experience for workers with the same education? Second, is the difference in cognitive skill between primary and secondary completers sufficient to explain the difference in their returns to experience?

The results of our analysis indicate, for both primary and secondary completers, that the returns to experience vary positively with cognitive skill. For example, among Kenyan secondary completers with ten years of experience, the return to experience is 4.7 percent per year for those whose score on our tests of cognitive skill is at the mean of the bottom third and 9.9 percent per year for those whose score is at the mean of the top third. These results also suggest that the difference between primary and secondary completers in cognitive skill is responsible for their different returns to experience. We conducted simulations in which the mean cognitive skill of secondary completers was reduced to that of primary completers and traced the effect on their returns to experience and consequently on the present value of earnings. As predicted by human capital theory, a big part of the difference in the present value of earnings between the two educational groups in Kenya and Tanzania is attributable to the influence that the higher cognitive skill of secondary completers has on the returns to experience.

We conclude that more skills of one type beget more skills of another. This supports the conventional practice of including among the social returns to schooling that part of the return that arises from the interaction between education and the returns to experience.

Cognitive Skill and the Variance in Earnings

The relative importance of the effects that reasoning ability, cognitive skill, and years of schooling have on the dispersion of earnings can differ from the relative importance of their effects on the wage structure. For example, although high levels of cognitive skill have a large positive impact on the earnings of the individual worker, variance in cognitive skill may contribute little to the inequality of pay if the group of highly skilled workers is small or if its members are evenly scattered over the earnings distribution. What, then, would be the effects on the inequality of pay if, while mean earnings were held constant, the dispersion attributable to a particular characteristic such as cognitive skill were eliminated?

Again, simulations with our estimated wage functions allow us to answer this question. In both countries variance in the level of reasoning ability has only a small effect on variance in earnings. This is partly because reasoning ability has only a small effect on a worker's pay. Moreover, in neither country are the more able workers highly concentrated in the highest quintiles of the distribution; the average ability of the lowest income quintile is not much less than that of the highest quintile. This occurs because a substantial proportion of primary completers of high ability did not gain access to secondary school, perhaps because of the relatively poor quality of their primary schooling or home training or because of the limited number of secondary places in the past.

Differences in years of schooling contribute rather more to the dispersion of wages because of their relatively large effect on individual earnings and because the proportion of secondary completers in each earnings quintile rises with earnings. The contribution of years of schooling is greater in Tanzania than in Kenya despite the higher wage premium on secondary education in Kenya. In Tanzania the proportion of secondary completers rises more steeply from low-earnings to high-earnings quintiles. This reflects the greater scarcity of Tanzanian secondary completers; the proportion of secondary completers in relatively low-paying manufacturing occupations is far higher in Kenya.

In Kenya cognitive skill accounts for three times more variance in earnings than do ability and years of schooling combined; in Tanzania the ratio is two to one. Not only is cognitive skill highly rewarded, but also there are few highly literate and numerate workers, be they primary or secondary completers, in the low-earnings quintiles. The predominant contribution made by cognitive skill suggests that inequality of pay arises primarily from inequality of individual productivity. Thus the efficiency cost of reducing inequality may be high.

The Indirect Effects of Ability and Schooling on Earnings

Between two groups of employees of different reasoning ability, the more able group has higher earnings. In Kenya and Tanzania reasoning ability has only a small direct influence on earnings: at any given level of schooling or cognitive skill, the naturally more able are not much more competent on the job. But ability also operates indirectly, in two ways. First, other things being equal, the more able acquire more schooling and the higher earnings that go with it. Second, for any length of schooling, the more able are better at acquiring cognitive skill. Our estimates of educational attainment functions and educational production functions measure these respective mechanisms.

An analysis of the relationship between ability and earnings for different ability groups shows that the largest single reason for the higher mean wage of the more able group was that they acquired more cognitive skill in secondary school. This factor accounted for 44 percent of the difference in Kenya and for 48 percent in Tanzania. Greater access to secondary school by the more able was an important cause of their higher earnings; it accounted for 32 percent of the higher wage in Kenya and for 45 percent in Tanzania. Most of this effect worked through human capital acquisition rather than through credentialism. Reasoning ability thus has an important but indirect influence on earnings.

It was also possible to distinguish the different effects of secondary school attendance on earnings. The direct effect of secondary schooling by itself—the credentialist effect—was to raise wages by 21 percent in Kenya and by 12 percent in Tanzania. The indirect mechanism combines the isolated effect that secondary school attendance has on the level of cognitive skill with the isolated effect of higher cognitive skill on earnings. Their combination implies that human capital acquisition in secondary school raised earnings by 25 percent in Kenya and by 15 percent in Tanzania; both figures are larger than the corresponding credentialist effect. Thus the main effect of secondary school attendance on earnings is indirect, through the development of cognitive skill.

In sum, the returns to cognitive skill are a payment for human capital. Literate and numerate workers are more productive, and education and reasoning ability are valuable to workers mainly because they allow them to acquire skills that increase their productivity. Our analysis strongly supports the human capital interpretation of the education-wage relationship, although not to the complete exclusion of other influences. These conclusions have generally satisfied the usual statistical tests. That they apply to both Kenya and Tanzania increases their robustness.

Differences Arising from the Natural Experiment

We have argued that the economic benefits of investment in secondary education are not just private; by increasing labor productivity secondary education also yields social benefits. The similarity between Kenya and Tanzania in the relationship between education and labor productivity poses another question: what are the consequences for labor productivity of the difference in education policy in the two countries? Or—to put the question in a form familiar to those who have studied economists' attempts to account quantitatively for differences between countries in output per capita or in rates of economic growth—to what extent does the difference between Kenya and Tanzania in human capital endowments, as a result of differences in education policy, account for the observed gap between the two countries in the productivity of wage labor? Judging by average wages, the difference between Kenya and Tanzania in productivity in the late 1960s was small—about 10 percent. By 1980 this difference had grown to roughly 50 percent, and use of an appropriate shadow price of foreign exchange would only increase this estimate.

In the late 1960s—after the Arusha Declaration of 1967 and the application of its principles to education, as enunciated in *Education for Self-Reliance* (Nyerere 1967a)—significant differences in education policy emerged between the two countries. In Tanzania the priority accorded to the development of postprimary education gave way to the new priority of universal primary education. The difference between Kenya and Tanzania in secondary enrollment rates and in the stock of secondary school graduates in 1980 can be traced to these changes in education policies in Tanzania in the late 1960s.

DIFFERENCES IN THE QUALITY OF EDUCATION. *Education for Self-Reliance* involved a qualitative as well as a quantitative change in direction. The curriculum was modified in Tanzania so as to change values and to teach vocational skills, and the outcome was that less time was given to general academic skills. The two countries have differed in another respect: in Tanzania greater stress has been placed on the use of Kiswahili in primary school, perhaps at the cost of achievement in secondary school, where English is the language of instruction.

Our estimated production functions indicate that secondary school attendance contributes substantially to cognitive skill in both Kenya and Tanzania. They also allow us to compare the quality of education in the two countries, as measured by cognitive "output" per unit of schooling "input" (see chapter 5). The educational production functions show that when inputs are standardized, cognitive skill is higher in Kenya than in Tanzania and that it is more responsive to secondary schooling and to reasoning ability. Consider, for example, someone whose reasoning ability is at the mean level of the combined sample. If he attended secondary school in Tanzania, his predicted level of cognitive achievement as measured by our tests would be 36, whereas if he attended secondary school in Kenya, his predicted level would be 42, or 17 percent higher.

These results suggest that Kenyan secondary schools are indeed of higher average quality than their Tanzanian counterparts, but they do not allow us to determine how much of this difference in quality is attributable to differences in curriculum, to greater managerial efficiency in Kenya, or to higher levels of such unmeasured inputs as the educational attainment of teachers, the availability of textbooks, or the provision of teaching facilities. Although educational spending per secondary student is higher in Tanzania than in Kenya, a higher percentage of that spending goes for board and lodging. A markedly higher proportion of secondary students in Tanzania is enrolled in boarding school because of the smaller size of the secondary system. As the secondary system expands, economies of scale may make it possible to contain costs while raising quality.

We have seen that the quantity and quality of secondary education are substantially greater in Kenya than in Tanzania. We therefore expect the cognitive skill level of the average employee to be higher in Kenya. Whereas the average scores of Kenyans and Tanzanians on the reasoning test are essentially the same, we find that Kenyan employees are indeed more numerate and more literate than their Tanzanian counterparts. The combined achievement score for Tanzania, appropriately weighted according to the proportions of primary and secondary completers in the Tanzanian urban labor market, is 30, whereas for Kenyans the corresponding score is 42, or 40 percent higher.

EDUCATION POLICY AND LABOR PRODUCTIVITY. The results of the analysis with the expanded human capital wage functions show that workers who are more literate and numerate are more productive. Tanzania may thus have paid a price in output forgone by restraining the growth of secondary education and reducing the quality of education for the sake of other goals. We used our estimated educational production functions to assess how much greater the cognitive skill of the Tanzanian labor force would be if the quantity and quality of secondary education were increased to the Kenyan level, separately and in combination. Then we used our wage functions to assess the effect of these increases in cognitive skill on average wages (see chapter 5).

We found that a simultaneous increase in quantity and quality would increase the cognitive skill of Tanzanians by 31 percent and their earnings by 13 percent. The increased quality of education accounted for more than half the increases in the cognitive skill level and in earnings of the labor force. It seems that the opportunity cost to Tanzania of constraining the quantity and quality of education has been substantial. Roughly 40 percent of the current difference in mean wages between the Kenyan and Tanzanian workers in our tested subsamples can be accounted for by the lower cognitive skill of the Tanzanian labor force. The divergence between Kenya and Tanzania in education policies appears to have been an important factor in the divergence of mean earnings and productivity of labor in the two countries in recent years.

Educational Expansion, Government Policy, and the Structure and Dispersion of Pay

At the time of political independence in Kenya and Tanzania economically active citizens with postprimary education were in extremely short supply. For instance, in 1962 there were only 4,700 candidates for the national form 4 examination in Kenya and 1,900 in Tanzania. The wage premiums that these people commanded in the labor market were substantial. Wage differences associated with education were large by international standards.

In the subsequent two decades the annual flow of secondary graduates into the labor market grew rapidly, even in Tanzania. The annual growth of nonagricultural wage employment over those decades averaged 26,000 in Kenya and 7,000 in Tanzania, whereas in 1980 there were 92,000 candidates for the form 4 examination in Kenya and 18,000 in Tanzania. As the process of ousting all but the most highly qualified expatriates came rapidly to an end, the initially very tight labor market for secondary graduates was progressively loosened.

Labor Markets in Kenya and Tanzania

In the theory of competitive markets, a reduction in the relative scarcity of a factor of production lowers its relative price. Whether expansion of the secondary system will depress the premium on secondary education depends on the nature of the labor market. Are there institutional factors at work that might prevent or retard the operation of market forces? Our ultimate concern in this section is with the effect of secondary expansion in Kenya and Tanzania on the structure and dispersion of pay. Our first task is to explain how the labor market works in these countries. We focus on the roles of occupation and of public sector pay policy in the determination of wages.

Occupation. The occupation of a worker is an intermediary between his education and his earnings. Education, which primarily confers cognitive skill, is often the main determinant of occupation. Because elements of human capital are occupation-specific, a worker's occupation has an important influence on the vocational skills that he acquires and therefore on his earnings. These ideas are applied to the Kenyan and Tanzanian samples in chapter 6.

The wage in one occupation may exceed that in another because the first occupation inherently requires superior personal characteristics—some natural, such as ability, and some acquired, such as education and vocational skills. In exploring this idea we use the occupational production function, which, for each occupation, relates individual inputs, such as ability, education, and employment experience, to productivity. Workers were divided into six broad skill-based occupational groups among which the hierarchy of mean wages corresponded to our judgment about the hierarchy of skill. Since there was little mobility among these groups in the sample, assignment to a particular occupational group was likely to be an important determinant of lifetime earnings. Estimates of occupation-specific wage functions show significant differences among occupations with regard to education and to employment experience; the returns to these human capital variables generally increase with the hypothesized occupational skill level.

Inasmuch as mean wages and the functional relationship between inputs and productivity vary among occupations, workers in different occupations are likely to have different mean characteristics. We therefore estimated occupational attainment functions, in which workers' occupations are explained in terms of their personal characteristics. In both countries the skill level of the most probable occupation rises with level of education: a worker's educational level is a powerful determinant of his occupation.

We also examined the process of filtering down—the movement into lesser jobs of educated workers or of educated entrants to the labor market as a result of an increased supply of educated labor. The probabilities of occupational attainment were found to differ from one entry cohort to another, which suggests that the burden of filtering down falls on entrants to the labor market rather than on incumbents. The year a worker entered wage employment is an important determinant of his occupation.

Consider the most recent cohort, which entered wage employment at the time of the surveys. The probability that a new secondary leaver will enter a semiskilled or unskilled manual job is more than two-fifths in Kenya. In Tanzania the probability is less than one-fifth, and the probability that such a person will enter a nonmanual job is more than three-fifths. The probabilities of occupational attainment of new primary leavers are similar in the two countries, which reflects the similarity of government policies for primary education. The contrast arises for entrants with secondary education; there is more filtering down in Kenya, where secondary education expanded far more rapidly than in Tanzania.

Our substantive conclusion is that skill-based occupation plays an important role in the labor market in Kenya and Tanzania. In the better-paying occupations the relationship between output and inputs (labor, cognitive skill, vocational skills, and natural ability) is such that these inputs are found in combination and yield high returns. Natural ability and access to education are important to occupational attainment and thus to the acquisition of vocational skills: "unto him that hath shall be given." In a meritocratic educational and social system that provides equality of opportunity, positive interaction among the determinants of earnings contributes to economic efficiency. Even in a meritocratic system, however, the interaction accentuates income inequality among workers.

Our methodological conclusion is that the role of occupation ought explicitly to be taken into account in analyzing the effects of educational expansion on the labor market. The premium on education may well be reduced primarily through the filtering down of the educated into lower-paying jobs in which their education is less productive.

GOVERNMENT PAY POLICY. Immediately after independence average wages were substantially higher in the public than in the private sector in Tanzania. This was partly because of the relative skill intensity of public services, but analysis of a 1971 household survey (Lindauer and Sabot 1983) showed that when personal characteristics were standardized, there was a 13 percent wage premium in the public sector. This was in accord with the government's early policy of exercising wage leadership and setting a good example as an employer. At independence most middle- and senior-level civil service posts were held by expatriate Europeans whose pay was determined by labor market conditions in Europe. Localization took place rapidly over the next decade, but public sector wages did not fully adjust to reflect the consequent decline in employee supply price. To do away with one of the fruits of independence and to introduce a large wage disparity between Tanzanians and their expatriate counterparts would have been politically untenable. Private sector wages were more responsive to the change in labor market conditions.

The policy of equalizing pay dates from the Arusha Declaration of 1967, which set Tanzania on a more egalitarian and socialist path. The government attempted to resolve, through its pay policy, the conflict between the claims of equity and the reward that education could command in the market. The policy of wage compression extended beyond government employment to other parts of the public sector, including the burgeoning parastatal organizations. In principle, the egalitarian pay policy also applied to the private sector, but it could not be enforced in practice. The effects of the public sector pay policy should be observable in the 1980 survey, in which the public sector accounted for more than 60 percent of our sample. We refer to the public sector as the nonmarket sector and to the private sector as the market sector because the latter is likely to diverge less from free market conditions. We hypothesize that in 1980 pay in Tanzania's nonmarket sector was less dispersed, and was lower for better-paid workers, than in the market sector.

The economic and political factors that led the Tanzanian government to exercise wage leadership also operated in Kenya in the immediate postindependence period, and government pay policies in the two countries were much the same. Since the mid-1960s the Kenyan government has progressively drawn back from being a wage leader and has expressed itself in favor of equalizing wages.

There is reason to question whether the government policy in fact brought about any significant departure from a market outcome for wage structure in either the public or the private sector. There was no effective control over the private sector and public corporations, and central government employment accounted for only a fifth of our sample. In practice, the government appeared to adopt the prevailing wage rate to determine its wages, possibly because market forces were achieving its distributional goal. Our hypothesis for 1980, therefore, is that government pay policy had less influence in Kenya than in Tanzania and that in Kenya pay in the public service and in public corporations differed little from pay in the private sector.

Educational Expansion and Wage Compression

The relationship between educational expansion and wage structure is examined with the use of the 1980 samples and manufacturing subsamples in both countries and a comparable 1971 survey of manufacturing in Tanzania (see chapter 8). The manufacturing comparisons are useful because they contain a time-series element and because the manufacturing sector is relatively free of the effects of government pay policy, which permits analysis of the relatively unimpeded operation of market forces.

THE MANUFACTURING SECTOR. The three manufacturing samples can be thought of as representing three points in a time series: Tanzania 1971, Tanzania 1980, and Kenya 1980. The ratio of secondary to primary leavers rises sharply across the three samples. By contrast, the occupational structure of the labor force is similar in all three. Given our skill-based occupational classification, this suggests that the composition of the demand for skills has remained much the same. Thus the relative supply of secondary leavers has increased against a background of unchanging relative demand.

Educational expansion can compress the wage premium on education in two ways. First, wages in the occupations that employ secondary leavers may be reduced by competitive market forces. Second, the filtering down of secondary leavers into lesser jobs may reduce their average wage in relation to that of primary leavers. The education-occupation matrix is indeed different in the three manufacturing samples. The proportion of secondary leavers in nonmanual occupations was 76 percent in Tanzania 1971, 68 percent in Tanzania 1980, and a striking 26 percent in Kenya 1980. Most of the filtering down between 1971 and 1980 in Tanzania was from more senior white-collar jobs into junior clerical jobs. The corresponding proportions in unskilled and semiskilled manual occupations were 6 percent, 11 percent, and 52 percent. Primary leavers were also filtering down, but at a much slower pace. The effect of the increase in the relative supply of secondary leavers is as expected. The standardized wage premium earned by secondary over primary leavers fell from 80 percent in Tanzania 1971 to 52 percent in Tanzania 1980 and to 26 percent in Kenya 1980.

The elasticity in the response of relative wages to relative supplies of educated labor implicit in the comparison between Tanzania 1971 and 1980 is −1.48. It is −0.31 for Tanzania 1980 compared with Kenya 1980 and −0.51 for Tanzania 1971 compared with Kenya 1980. Since the wage premium in Tanzania 1980 would not have entirely escaped the depressing effect of pay policy, the first elasticity is biased upward and the second downward. Thus the third elasticity (−0.51) is our best estimate. A doubling in the ratio of secondary to primary leavers employed in manufacturing would be sufficient to halve the ratio of their pay.

THE URBAN WAGE SECTOR. Considering the urban wage labor force as a whole, we find that the ratio of secondary to primary leavers in Kenya (1.17) is two-thirds higher than in Tanzania (0.69). Since the occupational composition of urban wage employment is similar in the two economies, these ratios imply that filtering down has proceeded further in Kenya. Whereas 21 percent of secondary leavers were employed in unskilled or semiskilled occupations in Kenya, only 5 percent were so employed in Tanzania. The difference in the occupational distribution of primary leavers is much less marked: the corresponding figures for primary leavers were 41 percent in Kenya and 38 percent in Tanzania. Again we predict a smaller wage premium for secondary leavers in Kenya. We find, however, that the standardized relative wage is higher in Kenya. The elasticity in the response of relative wages to relative supplies implicit in the comparison is actually positive.

The explanation for this anomaly is found in the difference in government pay policy in the two countries, the effect of which is examined in chapter 7. Whereas in Kenya the government has not significantly altered the market outcome, the Tanzanian government has intervened to compress the wage structure in the dominant public sector. In our wage function analysis we isolated the effect of pay policy on the educational structure of wages by using dummy variables for sector of ownership and allowing these variables to interact with educational attainment. It was then possible to simulate the premium on secondary education in the market sector. Eliminating the pay policy increased the premium by a mere 6 percent in Kenya but by 63 percent in Tanzania. This resolved the anomaly. The premium in Tanzania (0.64) now exceeded that in Kenya (0.51), and the elasticity of relative wages with respect to relative supplies of educated labor was negative (−0.25).

This estimate of the elasticity would be accurate only if the relative demand for secondary leavers were the same in both countries. For instance, differences in sectoral composition or technology could cause production in Kenya to be more skill-intensive and so raise the premium there. It was possible to simulate what the premium on secondary education would be in Tanzania if Tanzania had Kenya's greater relative supply of secondary leavers or in Kenya if Kenya had Tanzania's lesser relative supply. When we standardize both for pay policy and for relative supply, the premiums on secondary education in Kenya and Tanzania are remarkably similar; that is, the relative demand for secondary leavers is much the same in the two countries.

The somewhat higher elasticity estimated for the manufacturing sector than for the wage sector as a whole probably reflects the lower occupational skill intensity of manufacturing production and the tendency of secondary leavers who enter manual jobs to prefer manufacturing; filtering down has proceeded further in manufacturing than in the wage sector as a whole.

In sum, educational expansion can be an important means of compressing the wage structure in developing countries. In both Kenya and Tanzania the wage structure by education was remarkably wide at the time of independence. The structure has since been narrowed in both countries. Kenya achieved this outcome through its expansionary policies toward postprimary education. The mechanism was one of filtering down into less skilled occupations rather than of wage flexibility within occupations: the standardized occupational wage structure is similar in the two countries. Tanzania restricted educational expansion and used an egalitarian public sector pay policy to prevent scarcity rents from accruing to the educated. Such segmentation of the labor market has its drawbacks, however; it may well produce new inequities and misallocation of labor.

Educational Expansion and the Kuznets Effect

In making normative judgments economists are usually concerned with the inequality of wages received by individuals rather than with the structure of wages. The inequality of wages is a function not only of the wage structure but also of the distribution of employees within that structure. Educational expansion can therefore have two effects on the inequality of pay. The compression effect—the narrowing of the wage structure—was analyzed above. The composition effect—the changes in inequality brought about when educational expansion changes the educational composition of the labor force—is discussed briefly here and more fully in chapter 9.

It is widely accepted that in the process of economic development inequality of income first increases and later decreases. The composition effect has been cited to explain this phenomenon. Kuznets (1955) has argued that the transfer of workers from a large traditional sector in which mean income is low to a small modern sector in which mean income is high causes inequality to increase initially and to decrease later, when the sectors are roughly equal in size. Although Kuznets did not incorporate any compression effect, and although the present study is confined to educational groups within the urban wage sector, our analysis is in the spirit of the broader Kuznets hypothesis.

The compression effect of educational expansion is always to reduce inequality; the composition effect may either increase or decrease inequality. It is therefore possible for the two effects to work against each other, and the net outcome is then unclear. Simulation analysis using earnings functions based on data from the three manufacturing subsamples or the two wage sector samples makes it possible to isolate in turn the compression effect, the composition effect, and their combined net effect.

When we examine the manufacturing subsamples, we find that the compression effect of educational expansion, as measured by substituting one educational composition for another, indeed reduces inequality. When Tanzania 1971 is compared with Kenya 1980, inequality as measured by the variance of the natural logarithm of wages is reduced by approximately half. As the share of secondary leavers increases from its initially small size, inequality increases: the composition effect is positive. But the compression effect predominates, and the combined effect is for the variance of log wages to fall by a quarter or a third of its value. Significant further expansion of the secondary leaver group (which accounts for 42 percent of combined primary and secondary leavers in Kenya

1980) might well cause the composition effect to reinforce the compression effect rather than work against it.

Because educational expansion reduces the wage premium less dramatically in the wage sector as a whole, the compression effect is weaker there than in the manufacturing sector. But the composition effect also reduces inequality on account of the greater importance of secondary leavers in employment (54 percent of the combined total in Kenya). The combined effect of educational expansion as it increases from the Tanzanian to the Kenyan level is therefore significant; the variance of log wages falls by some 15 to 20 percent of its value.

We have shown that educational expansion can involve an important externality—reduced inequality of pay—that will not be taken into account by private agents and possibly not even by policymakers. This effect is normally ignored in conventional cost-benefit analyses of education, but it is relevant whenever government holds to an egalitarian social welfare function.

Educational Expansion and Equality of Opportunity

Traditionally, because land was abundant and capital negligible, tribal communities in Kenya and Tanzania were economically egalitarian. Economic development, particularly in the urban modern sector, led to the accumulation of physical and human capital, and inequality of income and economic opportunity increased. An important question arose: who in these predominantly poor societies would be the lucky few to gain the economic prizes?

The inequalities of opportunity that stem from the inheritance of wealth are well recognized in industrial societies. The advantages include income from wealth, economic gains from family connections (including marriage with others of similar status), and the means to invest in human capital. There is a strong positive correlation between the educational attainment of children and the economic status of their parents in industrial societies, whether postcompulsory education is privately purchased or heavily subsidized. For instance, British higher education is almost entirely publicly funded, and access is on the basis of meritocratic selection criteria. Yet in 1980 social classes 1 and 2 (out of 5), which represent fathers in professional and technical occupations, accounted for 27 percent of the 18-year-old population but 70 percent of those accepted by universities (Royal Society 1983).

This section is concerned with a dimension of inequality that is relatively neglected by economists—intergenerational mobility. In Kenya and Tanzania the great shortage of educated labor after independence created scarcity rents, and educational attainment became perhaps the most important determinant of income. It was possible that access to education would depend on family background; that is, on the education or income of parents. Have Kenya and Tanzania been characterized by increasing economic and social stratification as a result of the emergence of a self-perpetuating educated elite? The near achievement of universal primary education implies that in neither country is there now much selectivity by family background in access to the first level of the educational pyramid. We therefore focus on postprimary education.

Education Policy and the Distribution of Secondary Education

In which of the two secondary systems under study is the distribution of school places by family background more equal? How have the rapid expansion of secondary enrollment in Kenya and the contrasting situation in Tanzania affected the degree of intergenerational mobility and the process of class formation? These questions are discussed briefly here and examined in detail in chapters 10 and 11.

DETERMINANTS OF EDUCATIONAL ACCESS. The Tanzanian government introduced policies to reduce the role of family background in determining access to secondary schooling, heavily subsidizing the cost of attending government schools to bring secondary schooling within the financial reach of all segments of the community. It was inevitable that these subsidies, together with the high private returns to secondary schooling and the small size of the secondary system, would lead to substantial excess demand for places in government schools. As the country moved to universal primary education, the promotion rate from the final year of primary school to the first year of secondary school fell from 36 percent in 1961 to 19 percent in 1967 and to 7 percent in 1980. The corresponding promotion rate to government secondary school fell even more dramatically, from 36 percent in 1961 to 15 percent in 1967 and to 4 percent in 1980 (Cooksey and Ishumi 1986, table 2.3). The figure for 1980 is one of the lowest progression rates in the world. The government therefore adopted formal meritocratic selection criteria to prevent "class collusion" in the rationing of the scarce places. It restricted the private sector not only on the advice of its manpower planners but also because of its desire to make access to secondary education less dependent on ability to pay.

In Kenya government secondary schools were also highly subsidized, and meritocratic criteria were used to ration scarce places. The important policy differences between the two countries were that the government system grew more rapidly in Kenya and that restrictions were not imposed on the private sector, which enabled the harambee system to mushroom.

It might be expected that the greater importance of private schools in Kenya would produce greater inequality in access to secondary places. This, however, overlooks the role played by the size of the system. We have already seen how Kenya's "failure" to curb expansion contributed to higher labor productivity and lower inequality of pay. It also contributed to a more equal distribution of secondary schooling.

The hope that meritocratic selection criteria would suffice to ensure representation of income groups in secondary school in proportion to their numbers was disappointed in Tanzania. In part this was a result of the pressures to subvert the selection system that inevitably flowed from the scarcity rents associated with extreme rationing (Cooksey and Ishumi 1986, section 2). Entry to government schools is regulated by a quota system calculated on the basis of the number of primary (standard 7) leavers in each district. Marks in the primary-leaving examination are the main criterion for filling a quota. Minimum entry requirements in terms of examination marks vary substantially from region to region. In principle, the quotas help children in poor regions, but in practice, the localization of decisions is said to lead to favoritism toward the children of local administrators and other influential people. Moreover, although the practice is officially banned, children have been transferred "through the back door" from private to government schools in secondary forms 2 and 3 (Cooksey and Ishumi 1986, pp. 16, 18).

There is a second and probably more important reason for unequal access to secondary school that is even less avoidable than corruption. It has been observed in many countries that children from educated backgrounds are at an advantage in academic competition. In Kenya and Tanzania the children of more educated parents tend to be in the higher-quality primary schools. Children from educated homes also have better opportunities to acquire cognitive skill and appropriate attitudes in the home. This effect may be particularly powerful in Kenya and Tanzania, where education is often entirely new to a family: no less than half of the urban wage labor force in both countries had parents with no education at all. The children of the educated are therefore concentrated in the upper tail of the distribution of cognitive achievement at the end of primary school. Accordingly, a disproportionate number of them are among the few who are able to clear the meritocratic hurdle into government secondary school.

DIFFERENCES IN EDUCATIONAL ACCESS. We explored the determinants of educational attainment in our samples by means of educational attainment functions, in which the probability of a worker's having reached a particular level of schooling is explained in terms of various characteristics, including family background (the educational attainment of his parents), the aggregate rate of enrollment in the school system when he would have gone through it, race, and rural or urban location. We found that the distribution of secondary places by family background is highly unequal in Tanzania. In 1960 the probability that a primary leaver would get into secondary school was 0.81 if one parent had at least secondary and the other at least primary education but only 0.13 if neither parent was educated. Fifteen years later, in 1975, these probabilities were little changed; they were 0.83 and 0.21, respectively.

The policy of applying academic selection criteria within a quantitatively constrained secondary system did not have the egalitarian distributional impact that had been expected. The children of Tanzania's educated elite continued to claim their customary places. Children from relatively poor and uneducated households would have benefited disproportionately if the secondary system (both government and private) had expanded. Our survey indicated that many of these families were willing and able to pay private school fees. The frustrated demand for secondary education caused by government policy was concentrated among the poor.

The results for Tanzania are in contrast with those for Kenya. In 1960 the degree of inequality of access in Kenya was similar to that then prevailing in Tanzania; the probability of secondary access for primary leavers was 0.83 for children of the most educated group of parents and 0.21 for children of uneducated parents. The corresponding figures for 1975 were 0.89 and 0.73. Thus inequality of opportunity in Kenya narrowed dramatically over the fifteen years as secondary access tripled for the children of the uneducated. A child of uneducated farmers was 3.5 times more likely to attend secondary school if he was born in Kenya instead of in Tanzania. This is another example of how intervention in the market for education unintentionally led to an outcome in conflict with a strongly avowed goal of the Tanzanian government.

Education Policy and Intergenerational Mobility

Today all children in Kenya have roughly the same chances of attending primary and secondary school, irrespective of family background. It might be expected, therefore, that family background would no longer influence performance in the labor market. We find that this is not the case. There is a sense in which intergenerational mobility is no greater in Kenya than in Tanzania. Occupational attainment provides an illustration. In both countries family background makes for a sharp difference in the probability of attaining a high-skill, high-paying job. If both of a worker's parents are uneducated, the probability that the worker will have a nonmanual job is 0.22 in Kenya and 0.18 in Tanzania; if both have primary education, the probabilities are 0.53 and 0.52, respectively; and if both have secondary education, the probabilities are 0.90 and 0.99, respectively.

DETERMINANTS OF INTERGENERATIONAL MOBILITY. This rather surprising finding cannot be explained by differences in the distribution of workers among occupations, for the distribution is almost identical in the two countries. The explanation is rather to be found in the influence of family background on academic performance in secondary school and on access to tertiary education. Family background has an equally powerful effect on primary school performance and on access to government secondary education in both countries, as was explained above. Kenya and Tanzania differ markedly, however, in the relation of family background to performance in secondary school.

The relatively small size of the Tanzanian secondary system gives rise to a very low progression rate from primary to secondary school—a mere 7 percent in 1980. This means that—apart from the regional balancing effect of quotas—only the most highly qualified primary leavers and (to the extent that corruption occurs at the local level) the less-qualified children of the rich and powerful gain access to secondary school. The few children from uneducated families—the extraordinary few—who are admitted are at least as well qualified as their more privileged peers and can compete on equal terms with them in secondary school, usually a boarding school away from home influences. Performance in the national form 4 examination and promotion rates to upper secondary school (forms 5 and 6) and to tertiary education are evidence of this equality. There are no substantial differences by family background either in form 4 examination results or in access to form 5.

Because the secondary system is larger in Kenya, it is less selective and the variance in entry qualifications is greater than in Tanzania. The children from uneducated families who go on to secondary school are not limited to the few who perform outstandingly in the national primary-leaving examination. Owing to the academic advantages conferred by their family background, the children of educated parents perform better on average in that examination. Not only are the children of the uneducated less well qualified when they enter secondary school, but this initial disadvantage is accentuated by their concentration in the relatively low-quality harambee schools. Scores on the national form 4 examination and rates of promotion to form 5 provide evidence that children do not compete on equal terms in secondary school. In contrast to Tanzania, in Kenya there is a strong positive relationship between the parents' education and the child's form 4 examination performance, access to form 5, and access to tertiary education.

In both countries entry to the heavily subsidized tertiary education system depends on meritocratic criteria. It might be expected that in Kenya, where there is far greater equality in access to secondary school and where the tertiary system is somewhat larger, access to tertiary education would be more equal than in Tanzania. In fact, it is less equal. The probability of access to form 5 (the gateway to tertiary education) ranges from 0.23 for the children of uneducated parents to 0.36 for the children of the most educated group of parents in Tanzania, whereas the corresponding range is from 0.06 to 0.42 in Kenya. The explanation for this surprising result is found in the small size of the tertiary system in both countries and the difference between them in relative secondary and tertiary enrollments. In Kenya the progression rate from secondary to tertiary education is far lower than in Tanzania, and the secondary system is more heterogeneous in quality. Since only a small elite of form 4 leavers can enter the upper secondary and tertiary systems, academic competition is intense, and the children of the educated are at an advantage in this competition. The low promotion rate into tertiary education no doubt generates political pressures for the expansion of tertiary enrollment in Kenya, just as earlier there were pressures to expand secondary enrollment. Until the tertiary system expands greatly, there will be few places left for the children of the uneducated after the children of the educated have claimed their customary places.

In Tanzania, but not in Kenya, disproportionate numbers of children of uneducated parents leave the education system after they have completed primary school. In Kenya disproportionate numbers of the children of uneducated parents drop out after secondary school, whereas this is not the case for Tanzanians who complete form 4. In Kenya, therefore, the phenomenon of differential access is not avoided but is merely postponed.

THE EXTENT OF INTERGENERATIONAL MOBILITY. Intergenerational mobility can be thought of in absolute or relative terms and in terms of education or of success in the labor market. There is clearly greater absolute intergenerational mobility in Kenya than in Tanzania; the average difference between the education of parents and that of their children is larger in Kenya. Similarly, the higher productivity associated with additional education raises the income of children in relation to that of their parents more in Kenya than in Tanzania.

The degree of relative intergenerational mobility, however, is roughly the same in the two countries. We have already seen that when intergenerational mobility is measured by the educational attainment of the second generation, the greater equality of access to secondary education in Kenya is offset by inequality of access to education beyond form 4. There are three reasons why intergenerational mobility, as measured by the success of the second generation in the labor market, is low in Kenya. First, education has a strong positive effect on occupational attainment, and thus the greater access of the children of the educated in Kenya to education beyond form 4 gives them priority in the queue for jobs. Consequently, the children of uneducated parents do no better in the hierarchy of occupations than do those in Tanzania. Second, even when we standardize for years of schooling and concentrate on form 4 leavers, we find a strong positive relationship between examination performance and earnings in Kenya; this means that the children of educated parents have an advantage in the labor market. The same relationship is found in Tanzania, but it is weaker. Third, it appears that the expansion and consequent democratization of the secondary school system in Kenya has given rise to labor market discrimination by employers on the basis of family background. When we standardize for examination performance as well as for years of education, we find that children from educated families earn more in Kenya. In Tanzania, where form 4 leavers are scarcer, we find no such discrimination.

Cost-Benefit Analysis of Secondary Education: Methodological and Policy Issues

Cost-benefit analyses of investment in education have been conducted in most low-income countries. These studies have been influential; much of the conventional wisdom about private and social returns to investment in education and the contribution of educational expansion to economic growth can be traced to their findings, and in many countries these findings have entered into policy formulation. At the core of the fairly standard methodology employed in these analyses is the relationship between education and earnings, which is used to measure the benefits of educational investment. On closer examination this seemingly straightforward relationship presents some thorny methodological issues, and the resulting controversy has clouded the interpretation of rates of return to education. The data sets generally used to measure rates of return do not permit the empirical resolution of this controversy. Our surveys provide an opportunity to shed light on several of the more troublesome issues.

First, our measurement of the separate influences on earnings of cognitive skill, reasoning ability, and years of schooling has a bearing on a long-standing question in the economics of education: what proportion of the conventionally measured rate of return to education is attributable to the effect on productivity of the acquisition of human capital in school? The standard methodology assumes that the proportion of the rate of return attributable to screening or credentialism is negligible, and this assumption has been much criticized.

Second, underlying the standard method of estimating rates of return is a presumption that the wage structure is a result of the unfettered market interaction of sellers and profit-maximizing buyers of labor services and therefore accurately reflects the difference in productivity between workers with more education and those with less. But where the government actively intervenes in the labor market—the case in most developing countries—public sector pay policy has the potential for segmenting the labor market and biasing estimates of the returns to education. Moreover, bias can arise from employment policy as well as from wage policy. In the private sector it is reasonable to assume that profit-maximizing employers will not hire workers whose marginal product is less than the wage. In the public service and in public sector enterprises with access to subsidies, however, employment need not correspond to the level at which wage equals marginal product. Thus, unless account is also taken of government employment policy, rates of return to education based on the educational structure of wages may be seriously biased.

We have shown how educational expansion compressed the educational structure of wages in Kenya and Tanzania. The process by which this occurred—primarily through changes from one cohort to the next in the occupations entered by workers with a given level of education—is relevant to a third issue in rate of return methodology: what is usually measured in rate of return studies is the average return to education, even though marginal returns should be the basis for investment policy. The assumption is that the average wage of (standardized) labor measures the wage received by the marginal (that is, the most recently recruited standardized) worker. But because of changes in labor market conditions as a result of the growth in the supply of educated labor, the average wage may be a poor indicator of the marginal wage. For example, the average income of all primary leavers in the labor market may be a hollow prospect for those just entering the market. The average reflects the performance of older cohorts for whom a primary school certificate was a passport to a white-collar job, whereas today a primary leaver may be fortunate to get the most menial blue-collar job. Failure to take account of the gap between average and marginal returns can lead to overestimates of returns to education, and because the gap differs between primary and secondary levels, ignoring it may lead to a reversal in the hierarchy of returns.

A fourth issue is the comparative costs and benefits of government and harambee secondary schools in Kenya. We disaggregate the cost-benefit analysis by type of school and calculate separate private and social rates of return for government and for harambee schooling. This allows us to assess the extent to which the market for secondary education is segmented—that is, the extent to which the net private benefits to secondary education vary with type of school attended—and the efficiency and equity implications of such segmentation. This analysis provides the basis for an evaluation of the way in which the government chooses to subsidize secondary education.

The Returns from Cognitive Skill Acquired in School

As was shown in the first section of this chapter, our survey evidence bears out the human capital interpretation of the education-wage relationship rather than the screening or credentialist interpretation. This result appears to support the standard method of estimating the social benefit of education. Our three-equation recursive model, however, enables us to conduct a more precise evaluation of the standard method, of the sort first suggested by Becker (1964). The analysis is confined to Kenya because of the additional complications introduced by government pay policy in Tanzania, which are difficult to isolate in the tested subsamples. We compare the social rate of return to secondary education, estimated in the conventional way, with the return obtained by using the recursive model to trace the productive effects of secondary schooling (see chapter 12).

The educational attainment function identifies the contributions to human capital acquisition that secondary schools make—through the interaction of ability and schooling inputs—by their selection of the more able primary completers. The educational production function shows the effect of secondary schooling on cognitive skill. The earnings function predicts the effect of higher cognitive skill on earnings and, by implication, on productivity. These three relationships are different aspects of the productivity-enhancing role of secondary education. The earnings function also shows the direct effects on earnings of ability and credentialism and thus enables us to separate them from the human capital effects.

On the standard definition of the benefit stream, the social rate of return to secondary schooling is 13 percent. When the recursive system is used and all of the effects are combined, the rate is 15 percent—not significantly different. Since the direct effects of ability are negligible, cognitive skill and credentialism together produce a return of 14 percent. Cognitive skill makes the larger contribution of the two; it raises earnings by 33 percent, whereas secondary school attendance on its own raises earnings by 21 percent.

It is difficult to interpret the effect of cognitive skill on earnings except in terms of human capital acquisition. The smaller direct effect of schooling may represent credentialism or screening by employers on the basis of education, or it may contain elements of human capital acquisition that are not captured by our measure. For instance, schools may impart cognitive skills other than numeracy and literacy or valuable affective traits such as personal motivation or discipline. Our findings therefore tend to vindicate the use of the standard methodology in Kenya.

Public Sector Pay and Employment Policy and the Return on Education

It was shown above that in Tanzania an egalitarian pay policy in the dominant public sector has compressed the wage structure by educational level and reduced the premium on secondary education. This raises the question of whether public sector pay policy biases conventional estimates of the social rate of return on secondary education. Another complication is that since the public sector is not necessarily profit maximizing, wages need not equal marginal products. To explore these issues we examine the sensitivity of conventional estimates to alternative models of government pay and employment policy (see chapter 13).

Standard methods of estimation give a rate of return to secondary education of 13 percent in both countries. These results are not consistent with our expectation of a higher return in Tanzania, where secondary completers are in scarcer supply. The explanation lies in the difference in public sector pay and employment policies in the two countries and in the conventional abstraction from those differences.

Rate of return estimates for the public and private sectors separately indicate a relatively small difference in Kenya (10 and 15 percent), which reflects the only mildly compressive pay policy. In Tanzania public sector pay policy gives rise to a larger difference (9 and 20 percent). Tanzania can maintain such a large gap because of constraints on the ability of educated labor to move from the large public sector to the much smaller private sector. Since there is no consistent evidence of a positive relationship between the examination performance of secondary completers and their employment in the private sector, the difference cannot be simply a result of the "creaming" of better workers by private employers. As expected, the private sector rate of return is higher in Tanzania than in Kenya.

When the government intervenes to reduce pay, the wage in the public sector may measure the marginal product of government employees (if the government behaves as a profit-maximizing employer), fall short of marginal product (if the government allocates labor optimally between sectors but pays no more than it has to), or exceed marginal product (if there is overmanning in the public sector). The estimated social rate of return in the economy is shown to be sensitive to the choice among these assumptions, particularly in Tanzania.

In both countries additional knowledge of the workings of the public sector labor market would be required to estimate definitive rates of return to secondary education. Rate of return analysis should not be conducted mechanically but should rest on a knowledge of government objectives and behavior.

The Relative Rates of Return to Primary and Secondary Education

Perhaps the most influential stylized fact to emerge from twenty-five years of rate of return studies in dozens of developing countries concerns the relative rates of return to primary and secondary schooling. The averages of a large number of these studies indicate social rates of return of 27 percent for primary education, 16 percent for secondary education, and 13 percent for tertiary education. The implication generally drawn from this ranking is that top priority should be given to primary education as a form of investment in human resources. A well-known but little-heeded criticism of conventional rate of return studies, however, casts doubt on this conclusion as applied to Kenya.

In conventional rate of return studies the returns to education are measured by the wage differences associated with educational differences. The assumption is that the wage difference between primary and secondary completers measures their difference in marginal product and therefore indicates the marginal product of education. This assumption will be misleading if the average wages of all primary and secondary completers are inapplicable to those now entering the labor market. Rapid expansion of the educational system, as in Kenya, can change dramatically the labor market conditions faced by school leavers. The supply of educated labor has tended to outstrip wage employment in many developing countries, thereby necessitating substantial adjustments in the labor market. In particular, the education-occupation matrix tends to change from one cohort to the next. This issue is examined in chapter 14.

In the wage sector in Kenya, uneducated workers are the only ones who have generally remained in the same (unskilled) occupations from one cohort to the next. Two or three decades ago primary completers were in scarce supply, and a primary school certificate was a passport to a white-collar job. Those who obtained those jobs remain in them today. But, owing to the rapid expansion of the education system, today's primary completer is fortunate to get a low-paying blue-collar job, and his chance of obtaining a senior white-collar position, as many of his predecessors did, is negligible.

Similarly, whereas earlier cohorts of secondary completers were ensured access to nonmanual occupations, a rising proportion of recent cohorts have had to accept manual employment. The filtering-down process, whereby successive cohorts of workers with the same education enter less skilled jobs, was taken into account in calculating rates of return to primary and secondary education in Kenya. In addition to average rates of return, marginal rates of return were calculated by using the occupational distribution of the most recent cohort of labor market entrants to derive the wage difference attributable to education. In contrast, conventional rate of return studies inflate the wages of workers at a particular educational level by including in the calculation the currently unattainable occupational attainment of earlier cohorts.

In Kenya the rate of return to primary education is highly sensitive to the distinction between average and marginal rates of return, whereas the rate of return to secondary education is not. The average rate of return to primary education, as conventionally measured, is 17 percent, and the marginal rate of return is only 12 percent. The marginal return is markedly lower than the average for two reasons. At the primary level substantial filtering down takes place and there are large differences in wages by occupation, whereas for the uneducated there is less scope for filtering down and wage differences by occupation are small.

The return to secondary education, by contrast, is not affected by the corresponding adjustment: the average and marginal rates of return are both 13 percent. Because the degree of filtering down of primary and secondary completers is similar, their difference in earnings is little altered. Moving from the average to the marginal concept of the rate of return reverses the usual hierarchy: at the margin the rate of return to secondary education exceeds that to primary education.

The Kenyan analysis suggests that the conventional wisdom about the hierarchy of the returns to education in Africa and elsewhere rests on studies that are likely to contain a methodological error. Although the average rate of return on primary schooling for a large number of countries may be as high as 27 percent, the marginal return is likely to be considerably lower and may be less than the return to secondary schooling.

The conventional assessment of educational investment priorities accords the highest priority to primary education in those poor countries which, unlike Kenya and Tanzania, have not achieved universal primary education. The implication of our illustrative analysis for Kenya is not that the conventional assessment is necessarily wrong: in some countries even the marginal rate of return to primary education may be high, and the expansion of primary education could yield important distributional benefits and positive externalities. Rather, the implication is that the jury is still out.

Efficiency and Equity Implications of Subsidies in Secondary Education

Our comparative cost-benefit analysis of government and private (harambee) schools in chapter 15 is confined to Kenya because of the absence of data on costs in the private sector in Tanzania. It shows that the market for secondary education in Kenya is highly segmented. The cost to a parent of sending a child to a government secondary school is less than the cost of sending the child to a harambee school. Moreover, the difference in predicted lifetime earnings between form 4 leavers from the two types of school indicates that the private return is substantially higher for government schools. Our estimate is that the private rate of return to government schooling is about 50 percent higher than the return to harambee schooling—14.5 percent compared with 9.5 percent.

Government subsidies explain this gap. Although the costs to parents of sending a child to a government school are only 63 percent of the corresponding costs at a harambee school, per pupil expenditures are 35 percent higher in government schools. In 1980 the per pupil subsidy was roughly 2,000 shillings in government schools and 200 shillings in harambee schools. Government schools thus charge less for a higher-quality education. We show that the difference in earnings streams between government and harambee school leavers is attributable to the higher cognitive skill of the former and not, for instance, to the greater selectivity of government schools. When the higher wastage rates for harambee schools are taken into account, the gap in rates of return widens.

The result of this marked segmentation of the market for education is that parents strongly prefer to send their children to government schools. This preference is manifested in the substantial excess demand for government school places, the consequent stiff academic competition for access to government schools, and the role of harambee schools as the secondary schools of last resort.

The private and social returns to harambee secondary schools are essentially the same: adding the negligible average government subsidy to the private cost does not measurably reduce the rate of return. The subsidy per pupil in the government system is far from negligible: adding the government subsidy to the private cost increases the total cost by 133 percent and reduces the social return below the private return. Yet the social return, at 13 percent, remains substantially higher in government than in harambee schools. This suggests that the government system is the more cost-effective system for society.

One justification for introducing subsidies of government secondary schools in Kenya was the belief that without them children from poor families could not afford to attend. Who, then, reaps the benefits of these large subsidies? Among those enrolled in secondary schools, children with highly educated, high-income parents disproportionately gain access to government schools: the probability rises from 0.16 for the children of uneducated parents to 0.51 if one parent has at least primary and the other at least secondary education. The reasons, predominantly meritocratic, have been explained above. Whatever the reasons, those with the greatest ability to bear the cost of their children's education are the most likely to receive large subsidies.

Policy Implications

Tanzania's policies for secondary education were much influenced by the principles enunciated in *Education for Self-Reliance* (Nyerere 1967a), issued shortly after the Arusha Declaration put Tanzania on a socialist path. The objectives of the policies included controlling the expansion of postprimary education to satisfy manpower requirements rather than private demand for education, reducing elitism and the tendency for schooling to promote inequality and class formation, and preparing children better for life in socialist Tanzania.

Manpower planning involved, on the one hand, forecasting future requirements for educated labor and, on the other, restricting the growth of the postprimary school system. Among the policies adopted to promote the egalitarian objective were the use of academic criteria, tempered by a regional quota system, for entry to secondary education, the waiving of all fees in government secondary schools, and the discouragement of private schools that would offer secondary education only to those who could afford it. To further the attitudinal and vocational objectives, political education and activities (such as cultivating farm plots) designed to promote self-reliance were introduced into the schools, the secondary curriculum was diversified away from general academic subjects and toward vocational subjects, and the primary curriculum was made more appropriate for the majority who would never enter secondary school and would become farmers.

The education policies adopted in Tanzania have aroused interest and comment in the international education and development community. These policies are radical not just in rhetoric but in fact: they have saddled Tanzania with one of the smallest secondary systems in the world and have changed the nature of education. Some commentators have held up Tanzania as a model. Others have been critical, perhaps because they recognized that government intervention frequently generates countervailing tendencies and side effects that can produce outcomes different from those intended.

How successful have these policies been in meeting their own objectives and as judged by the usual economic criteria? The evidence adduced by educationalists and reviewed by Cooksey and Ishumi (1986) concerning the first point—the internal objectives—is discouraging. Our study addresses the second issue by comparing the outcomes of differing policies toward secondary education and assessing these policies according to economic criteria.

Kenya has followed a more conventional set of education policies than has Tanzania. Forecasts of manpower requirements have not governed the expansion of postprimary education. At the secondary level the supply of educational opportunities, both in government and in private schools, has been more responsive to demand. The government has tolerated the rapid growth of a private secondary system in which ability to pay is necessarily a criterion for access. Unlike Tanzania, Kenya is roughly on the curve that relates the secondary enrollment ratio to national income per capita in cross-country comparisons (see figure 16-1). Furthermore, primary and secondary schooling in Kenya has not strayed far from the usual curriculum, with its stress on academic subjects.

In the foregoing sections we summarized the results of the East African natural experiment. In this section we shift from positive to normative analysis and to policy implications. We evaluate each aspect of the experiment by the criteria of efficiency and equity and then—since the policies are an integrated package—overall.

Efficiency

Our research has attempted to study the relationships between education policy and efficiency in greater depth and breadth than is conventionally done. The greater depth is made possible by introducing reasoning ability and cognitive skill as the links between education and wages. That analysis lends strong support to the human capital interpretation of the education-wage relationship. It implies that standard cost-benefit methods of appraising education are valid in this crucial respect.

A corollary of this finding is that the assumptions underlying manpower planning approaches to education policy are invalid. Within our six skill-based occupational groups we find that earnings vary by educational level; indeed, in the case of form 4 leavers they vary with examination performance. The cognitive skill that a worker brings to a job affects his productivity and therefore his pay. The very different education-occupation matrices in the two countries imply that Kenyan workers, who are better educated, are more productive in their jobs. Although expansion of secondary education is shown to reduce the wage premium on secondary education and, by implication, its marginal product, the elasticity of substitution between workers with primary and with secondary education is fairly high—well in excess of unity.

The governments of both Kenya and Tanzania have made forecasts of manpower requirements on the basis of fixed input coefficients for educated labor. Because of political pressures for expansion, Kenyan education policymakers have paid lip service to the forecasts, whereas their Tanzanian counterparts have taken them more seriously. Quite apart from the serious informational problems that have led to widely divergent forecasts of requirements (Cooksey and Ishumi 1986, pp. 55–58), our analysis suggests that such forecasts are fundamentally misguided. Tanzanian manpower planners have viewed the filtering down of secondary completers into lower occupations as a waste of resources. We have demonstrated that the process is better viewed as a deepening of human capital.

The two countries differ not only in the quantity but also in the quality of secondary education. Our educational production functions indicate that the cognitive skill of workers with the same reasoning ability and years of education is substantially higher in Kenya. This result is surprising in view of the greater importance of low-cost community schools in Kenya. It no doubt reflects the switch in language of instruction in Tanzania from Kiswahili in primary school to English in secondary school (in Kenya English is used throughout) and the diversion of time from academic subjects as a consequence of curriculum reform. Moreover, curriculum diversification has not achieved some of the economic objectives for which it was intended (Psacharopoulos and Loxley 1985, pp. 205–09). Even if it has furthered the ideological objectives of socialism and self-reliance, that gain has been at the high cost of lower levels of cognitive skill.

Our results strongly suggest the desirability of research into cost-effective means of improving the quality of education in Tanzania. Such research may find that the returns to expenditure on improving quality are comparable to or even higher than those on increasing educational quantity. Because of the difference in both the quantity and quality of secondary education, the mean level of cognitive skill and therefore of labor productivity and earnings is far higher in Kenya. The difference between the two countries in education policy regimes appears to account for a substantial proportion of their difference in the average productivity of wage labor. Tanzania intervened in the market for education to save resources that, it was perceived, would otherwise be wasted. Perversely, this intervention has exacted a high price in output forgone.

Furthermore, the full price has not yet been paid. The gap between Kenya and Tanzania in the educational attainment of the labor force would inevitably widen even if Tanzanian policy were to change, owing to the lag between the expansion of the secondary system and the entry into the labor market of educated workers. Looking further ahead, Kenyans will be reaping an intergenerational benefit that Tanzanians will forgo. A markedly higher proportion of the current generation of children in Kenya has parents with secondary education. This will increase the efficiency with which the children learn in school and their subsequent performance in the labor market.

Equality

Since the governments of both Kenya and Tanzania have egalitarian objectives, we examined the effects of their secondary education policies on various dimensions of inequality. Such effects are often ignored, inadequately recognized, or inadequately understood in educational decisionmaking. The four dimensions of inequality discussed here are the structure of wages among educational groups, the dispersion of pay among individuals, differential access to education, and the extent of intergenerational mobility. Each of these distributional effects has policy implications.

The governments of both countries have expressed their desire to compress the widely dispersed wage structure that they inherited. Our estimate of the response of relative wages to supplies of secondary in relation to primary completers confirmed that the expansion of secondary education is a means of achieving that objective. Although the responsiveness is not high, the degree of compression achieved in Kenya has been significant: the premium on secondary education in the market sector is about 20 percent lower in Kenya than in Tanzania.

Tanzania's policy of holding back secondary enrollment meant that scarcity rents accrued to people with secondary education. This result may well have been why the government intervened in the labor market to compress the wage structure. Despite having to work against the market, the policy is effective in the dominant public sector, where government pay policy halves the premium on secondary education. Thus one policy intervention, in the market for education, begets another, in the market for labor. A side effect of the latter intervention is that the labor market is segmented by sector of ownership, which produces new inequities and a misallocation of labor.

The Kenyan government, in adopting the prevailing wage rate approach to public sector pay, implicitly chose to follow market forces because the rapid expansion of enrollment in Kenya could be relied on to reduce the premium on secondary education. The two different policy regimes for education and the labor market have had similar results in the size of compressive effects on the structure of wages.

Not only does the expansion of secondary education compress the wage structure by educational level, but it also reduces the inequality of wages among individuals. This would occur even at Tanzania's low initial position, where the compression effect is partly offset by the composition effect of educational expansion. On both scores—the structure and the dispersion of wages—it would seem that the Kenyan policy of permitting the expansion of secondary education is preferable to the Tanzanian policy of containment.

One aim of universal primary education was to reduce inequality of access to the education system. This has been achieved in both countries; even the children of the poor and uneducated, who once were excluded, now receive a basic education. Both governments have tried to equalize access to secondary school: they heavily subsidize government secondary schools and ration the scarce places on the basis of meritocratic criteria. In addition, one reason that Tanzania restricted private enrollment was so that those who can afford to pay would not be at an advantage.

The extreme rationing of government secondary places in Tanzania has given rise to some corruption—perhaps less than might be expected—and this has contributed to inequality of access. More important, and as in other countries, eliminating the direct effects of differences in income has not brought about equality of access. The academic advantages conferred by family background mean that it is primarily the children of the poor and uneducated who are excluded by the quantitative restrictions imposed by the government. Many less privileged families that are willing and able to meet the cost of private secondary education are constrained by policy from doing so. This is yet another example of how Tanzanian government intervention has had unforeseen side effects and has produced an outcome the opposite of that intended. Restraining the size of the secondary system has contributed to class formation; an educated elite is in the process of perpetuating itself in Tanzania.

At first, it appeared that the Kenyan policy on secondary expansion would prove to be less egalitarian than the Tanzanian policy because of the greater importance of the fee-charging private sector. But in fact, the larger size of the secondary system in Kenya has meant easier access for the children of the poor and uneducated there than in Tanzania. Yet intergenerational mobility is not greater in Kenya; the exclusion of the children of the poor and uneducated now occurs at the tertiary level, and this continues to order the labor market by family background. There has been more absolute intergenerational mobility in Kenya, where the gap between generations in education and income levels is greater than in Tanzania. But the influence of family background on position in the socioeconomic hierarchy remains much the same in the two countries. The widely heard claim that education is "the great equalizer" is not borne out in these countries. It is also disappointing to note that the behavioral mechanisms at work in Kenya and Tanzania are likely to operate elsewhere.

In sum, the externalities associated with the distributional effects of educational expansion vary. The effects of expansion on the structure and dispersion of wages and the distribution of educational opportunities are positive and reinforce efficiency arguments for expansion. The East African experiment suggests, however, that the promotion of intergenerational mobility cannot be used as an additional argument for the expansion of secondary education.

Subsidies

Government secondary schools are highly subsidized in both countries, whereas private schools are not. Although lack of data for Tanzania limited our cost-benefit analysis to Kenya, the findings and their policy implications should also be applicable to Tanzania.

As a result of government subsidies, the market for secondary education in Kenya is highly segmented; the private returns from government schooling are markedly higher than those from harambee schooling. This implies that government secondary places are rationed and that demand for them is insensitive to even substantial increases in school fees. The per pupil subsidy could therefore be reduced without reducing expenditure per pupil and without diminishing the quality of the education provided.

The children of high-income parents, who are disproportionately represented in government schools, benefit disproportionately from the subsidies. This suggests that an increase in school fees, tempered by a need-based scholarship scheme, would have progressive distributional effects. The regressiveness of government expenditures on secondary education should be considered in the light of evidence that the incidence of taxation in Kenya may be regressive, as is often the case in developing countries that derive a high proportion of their revenue from the taxation of agriculture.

Our analysis suggests that the fees charged by government schools would have to be increased more than fourfold—to more than the cost per pupil—to reduce the private rate of return to that prevailing in harambee schools. Only at such high fees would parents be indifferent in choosing between the higher-quality government system and the lower-cost harambee system. Such a reduction of the private return would not reduce the social return to government secondary education but would merely shift the burden.

The revenue potential of increases in user charges is so substantial—more than 300 percent of government recurrent expenditure on secondary education—that even a more modest increase in fees and a large scholarship program would greatly ease the constraints on the education budget. This is particularly important in Tanzania, where budgetary constraints have shared the blame for the slow expansion of government secondary schools and where until 1984 no fees were charged in government secondary schools.

The efficiency gains from reducing subsidies in Tanzania would come from the opportunity to make high-yielding investments in secondary schooling. Even in Kenya there are efficiency gains to be reaped from a reduction of per pupil subsidies. If the government were to provide small subsidies to harambee schools to improve quality, the current gap in the social rates of return between the two systems could be reduced.

Overall Appraisal

We have discussed the consequences for efficiency and equity of the East African natural experiment. The overall assessment of the difference in education policy regimes should be clear. The Kenyan policy regime is preferable both on grounds of efficiency and, ironically, as judged by the distributional criteria that the Tanzanian government has emphasized.

We have reached this important conclusion with barely a reference to the social rate of return to secondary education in either country. When we calculate conventional social rates of return, we find that the return, at 13 percent in both countries, is high and is competitive with other investments. This result suggests that there is a case for expanding secondary education in both countries, but there is no indication that the urgency is any greater in Tanzania. Our examination of methodological issues in cost-benefit analysis provides some insight.

First, the usual practice of ignoring pay and employment policy in the public sector leads to large biases in estimates of social rates of return to secondary education in Tanzania, where the government has aggressively intervened in the labor market, but to only small biases in Kenya. Second, moving from measures of average rates of return to more policy-relevant measures of marginal rates can substantially alter the level and structure of returns. Third, when we isolated the human capital effects of education on earnings from the screening and credentialist effects, we found an upward bias in conventional rate of return estimates, but the bias was small.

We have used our data to examine these sources of bias, but we have not attempted to combine the exercises and thereby to unveil the "true" rate of return to secondary education in Kenya and Tanzania. This is partly on account of data constraints. The subsample of workers for whom measures of ability and cognitive skill are available is not large enough to allow us to estimate the direct effect of cognitive skill while simultaneously taking account of government pay and employment policy and substituting the marginal for the average rate of return.

Quite independent of data constraints, however, we would be reluctant to make such an attempt. The consequences of educational expansion are multidimensional, and the assessment of each dimension can be complex. Educational cost-benefit analysis was developed as a means of assessing

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the consequences of expansion for productivity alone. For informing policy on the expansion of secondary education, this approach is, both in concept and in practice, clearly superior to manpower planning. Nevertheless, it is seriously flawed.

The desire to generate a single number, a rate of return to educational expansion comparable to the rate of return for a steel mill or a port facility, is understandable. The effort was of particular value in the early years of development economics, when some people still needed to be convinced that growth could be generated by, and indeed required, investments in human capital as well as in physical capital. But this reductionist approach to the assessment of educational investments, by ignoring much of the complexity in educational and labor markets, can easily be misleading.

Rates of return turn out to be sensitive to several issues that are generally left out of cost-benefit analysis. In some instances still more research would be required to determine the precise way in which an issue should be resolved. For example, the impact that government employment policy has on the returns to secondary education is ambiguous without more information. Furthermore, it is not clear how to incorporate an analysis of the distributional consequences of educational expansion into the calculation of rates of return, and we have made no attempt to do so. Although our nonreductionist approach can inform education policy, it does not provide a basis for estimating the "true" rate of return to secondary education. We do not wish to perpetuate the illusion of precision created by oversimplification.

Our approach suggests that the Tanzanian policy regime should move closer to that adopted by Kenya. It does not provide clear guidance as to the future rate of expansion of the Kenyan secondary system. The high social rate of return in Kenya suggests that secondary education there should be further expanded. Even at the margin, as we have measured it, the returns are high. We have doubts, however, about this particular policy implication.

Most of the additional secondary completers produced by further expansion of the secondary system in Kenya are likely to become self-employed farmers. It is tempting to presume that the social returns to secondary education will not be high in agriculture; this is the sort of trap into which manpower planners are prone to fall. To measure these returns and the distributional consequences of the next phase of expansion requires a different methodology from that applied here—a methodology based on rural surveys and farm-level production functions. This is the highest research priority for future education policy in Kenya, and significant expansion of the government system should wait on its results. In the meantime we would not counsel that there be government restrictions on the further expansion of privately funded education.

We are confident of the case for a substantial expansion of the secondary system in Tanzania. The deepening of human capital will further both productivity and equity. Our social rate of return analysis, based on the market sector, merely reinforces this judgment. There is, however, one qualification concerning public sector employment policy. If the government service and public enterprises respond to the increased supply of educated labor by creating unnecessary white-collar jobs, the opportunity presented by expansion will be wasted. The increase in labor productivity can occur only if incentives in the labor market encourage secondary completers to filter down and bring their skills to bear in lower-level occupations.

Between 1980 and 1985 government secondary places in Tanzania increased by 10 percent, and private places were permitted to increase by 29 percent. This reflects a growing recognition by the government of a need for change; the Presidential Commission on Education has recommended large-scale expansion by the year 2000 (Tanzania, Ministry of Education 1984). It also reflects the increasing political pressure for secondary expansion as the number of primary leavers has grown.

How could popular demand for secondary education have been suppressed so long in Tanzania while it was satisfied in Kenya? The answer appears to lie fundamentally in the difference in political systems: the greater centralization of power in Tanzania meant that education policy was handed down from the top. Another return that Tanzania may reap from educational expansion is a better informed citizenry and consequently a greater likelihood that the benefits and opportunity costs of government initiatives will be more fully recognized and debated.

CHAPTER 3

Earnings, Schooling, Ability, and Cognitive Skill

CONVENTIONAL ESTIMATES now available for a large number of countries generally indicate that the social returns to education are positive, large, and competitive with returns to investment in physical capital.[1] That such estimates are good guides for the allocation of public resources has, however, been questioned. The heart of the problem lies in the interpretation of the positive relationship between workers' education and earnings. The conventional estimates assume that the coefficient on the education variable in the earnings function measures the effect on workers' productivity of human capital acquired in school. But it has also been hypothesized that all or part of the education coefficient represents innate ability and motivation (the screening explanation) or the higher wages awarded to more educated workers without regard to their productivity (the credentialist explanation). If either hypothesis is correct, conventional measures of the social benefit of education have an upward bias.[2]

In this chapter we attempt to distinguish the influences that cognitive skill, native ability, and years of education have on earnings and to use this analysis as a means of adjudicating the human capital, screening, and credentialist hypotheses. Our two rigorously comparable micro data sets from Kenya and Tanzania, described in chapter 1, contain the usual variables found in wage function estimates of the benefits of schooling—individual earnings, years of education, and years of employment experience. In addition, they contain two variables—measures of the worker's cognitive skill and reasoning ability—that are not found in earlier studies of developing countries and that are only rarely found in studies of the education-wage relationship in developed countries.[3] These variables

Note: Adapted from M. Boissiere, J. B. Knight, and R. H. Sabot, "Earnings, Schooling, Ability, and Cognitive Skills," *American Economic Review* 75, no. 5 (December 1985), pp. 1016–30.

allow us to estimate the direct effects on earnings of cognitive skill, ability, and years of schooling. By using these inputs to estimate educational production functions and educational attainment functions and by linking these functions with the wage function in a recursive framework, we can also assess the various indirect effects that ability and years of schooling have on earnings. Having data sets from two countries that are similar in size, resource endowments, structure of production and employment, and level of development means that we can not only subject our results to the usual statistical tests but can also assess their replicability.

Kenya and Tanzania have nearly achieved universal primary education, and university enrollments remain at less than 1 percent of the relevant age group. The important policy issues regarding mass education in East Africa thus arise at the secondary level, and it is the benefits of secondary education that concern us here. Because the public education system in both countries is meritocratic, years of education may provide good signals of ability. The public sector is an influential employer of urban labor—in 1980 it accounted for 39 percent of total urban labor in Kenya and for 61 percent in Tanzania—and institutional arrangements suggest that educational qualifications influence access to public sector jobs and affect entry grades and pay. The screening and credentialist explanations of the earnings-education relationship can therefore not be dismissed.

The Model

In the conventional measurement of the social rate of return to, say, secondary education, the benefit stream is estimated by means of an earnings function. The following is an example of an earnings function for a sample of primary and secondary completers.

$$\ln W = a + bS + cL + dL^2 + u \tag{3-1}$$

where

$\ln W$ = the log of (pretax) earnings of the individual

S = a dummy variable signifying that the individual has precisely completed secondary education; individuals who have precisely completed primary education form the base subcategory. (Schooling is introduced as a dichotomous rather than a continuous variable for reasons of survey design, discussed in chapter 2.)

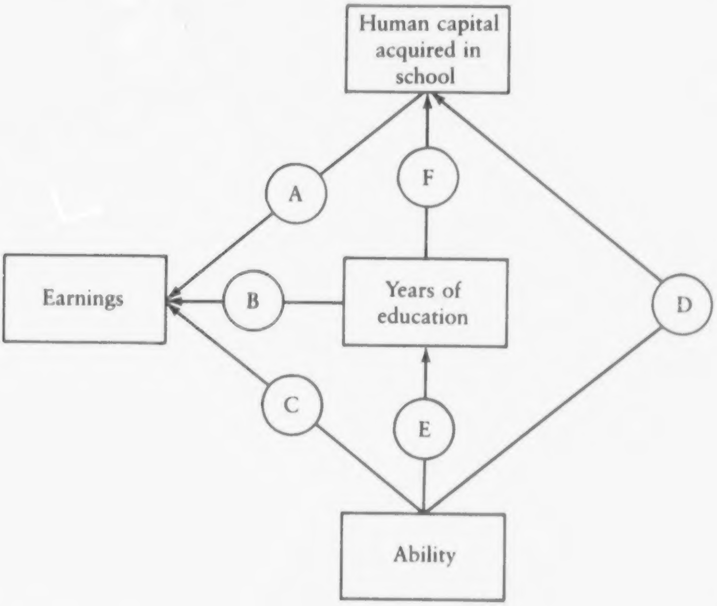
L = the number of years of employment experience of the individual

u = an error term.

The term S is interpreted as a proxy for cognitive skill or other marketable traits acquired in secondary education. The cross-sectional earnings function is used to simulate two time series, $\widehat{W}_p$ and $\widehat{W}_s$, which represent the predicted wages of primary (subscript p) and secondary (subscript s) completers over their expected working lives. The difference between the educational groups in predicted lifetime earnings is then used as the estimate of the social benefits of secondary education.

The criticism of the assumptions underlying this approach can be illustrated with the use of figure 3-1, which presents a simple structural model of the relationships among earnings, years of education, natural ability, and human capital. The figure depicts these four variables as determinants of human capital, of earnings, and of both. Of the six links shown, equation 3-1 captures only B, the influence of years of education on earnings. Only under certain stringent conditions will the coefficient on S in equation 3-1 be an unbiased estimate of the effect on earnings of skills acquired in school.

Figure 3-1. *How Ability, Years of Education, and Human Capital Influence Earnings*



The first condition is that years of education must—through relation F—provide an accurate measure of the human capital acquired in school. The market value of this human capital, as determined by marginal product, must then determine earnings via relation A. But since years of education are only one input into the educational production function, they may be a poor guide to the output from the function.

Second, years of education must influence earnings only indirectly, through F + A. If there is a direct positive link through B, the coefficient on years of education will overstate the human capital effect. The credentialist explanation stresses that the link is indeed direct: schools provide students with a credential that is personally valuable but not productive. For instance, the government may determine wages and establish education-based criteria for hiring and payment, or private employers may discriminate in favor of the educated, with whom they share similar socioeconomic backgrounds.

Third, if ability is correlated with years of education (relation E), it must have no direct (C) or indirect (E + B) effect on earnings. Positive relationships imply that the coefficient on S in equation 3-1 overstates the effect on earnings of skills acquired in school; that is, the effect of ability is wrongly attributed to years of education. Employers may reward ability on an individual basis or, according to the theory of educational screening for ability, may use years of education as a means of identifying workers who are potentially more productive (because of the stochastic relations E and C). Educational attainment "signals" workers with greater average ability, and it is this ability, rather than what is actually learned in school, that is rewarded.

There is, however, a way in which ability can strengthen the human capital relationship between earnings and education. If educational selection criteria are meritocratic in the sense that they promote the more able (relation E), then ability enables years of education to be more efficiently transformed into cognitive skill (on account of D): E + F + A and D + A influence but do not bias the estimate of the effect on earnings of skills acquired in school.

To capture the complex relationships depicted in figure 3-1, we take cognitive skill to be a measure of human capital and reasoning ability to be a measure of predetermined natural ability and posit a recursive model that is represented in the following three equations:

$$S = a_0 + a_1R + a_2P + a_{3i}F_i + v \tag{3-2}$$

$$H = b_0 + b_1R + b_2S + b_3G + b_4B + y \tag{3-3}$$

$$\ln W = c_0 + c_1S + c_2R + c_3H + c_4L + c_5L^2 + z \tag{3-4}$$

where

R = reasoning ability
P = an indicator of the aggregate probability of attending secondary school when the individual was age 14
F_i = indicators of parents' education
H = cognitive achievement
G = an indicator of attendance at a government (as opposed to a private) school
B = an indicator of urban (as opposed to rural) birth
v, y, z = error terms.

Full definitions of variables are provided, and the system is tested for recursiveness, in subsequent sections.

Equation 3-2 reflects the influence of natural ability on years of education within a subsidized and competitive educational system (relation E in figure 3-1). Equation 3-3 is an educational production function that incorporates relations D and F; it is similar in form to those used in most such studies (see the reviews by Hanushek 1979 and Lau 1979). The earnings function specified in equation 3-4 includes relations A, B, and C. We refer to equation 3-4 as the expanded human capital model, as distinguished from the conventional human capital model in equation 3-1.

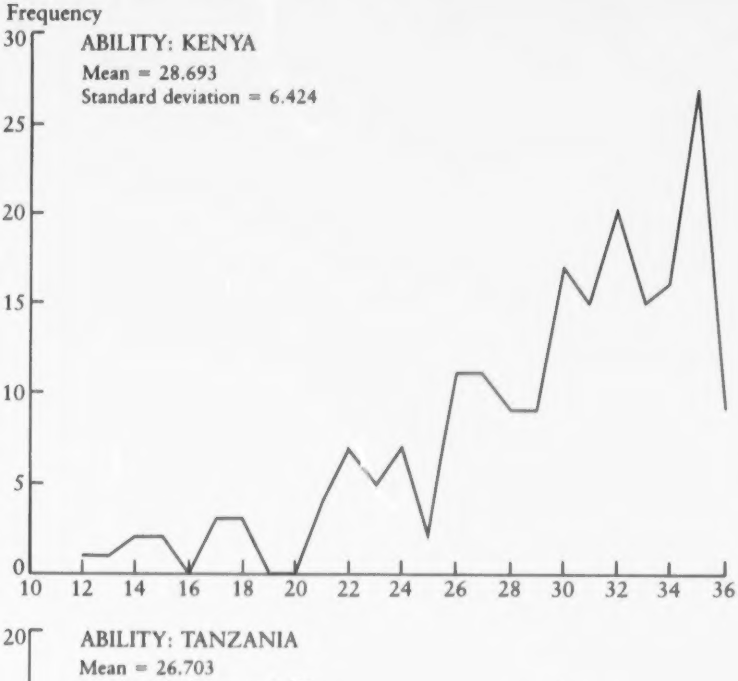
The Appropriateness of the Data

Our specially generated data appear to be appropriate for estimating this model. The frequency distributions of test scores for each sample (figure 3-2) reveal considerable variance on each test, a desirable characteristic for dependent and independent variables alike. All three tests (numeracy, literacy, and reasoning ability) appear to have been suited to the target groups: there are few perfect scores and no zero scores, which suggests that the results do not suffer from the common problem of truncation of the ability or achievement distribution that arises when questions are too easy or too difficult.

Are the subsamples representative enough to allow us to generalize to the samples as a whole and to the relevant strata of the populations? Figure 3-3 compares the frequency distribution of earnings of primary and secondary completers in the tested subsamples and in the corresponding full samples. In both countries these distributions are similar, as are the measures of central tendency. These and similar results obtained for other characteristics of respondents, such as age, length of wage employment experience, and occupation, indicate that the subsamples are representative.

Table 3-1 presents the test scores in summary form. For both countries

Figure 3-2. *Survey Test Scores*



ABILITY: KENYA
Mean = 28.693
Standard deviation = 6.424

ABILITY: TANZANIA
Mean = 26.703
Standard deviation = 6.650

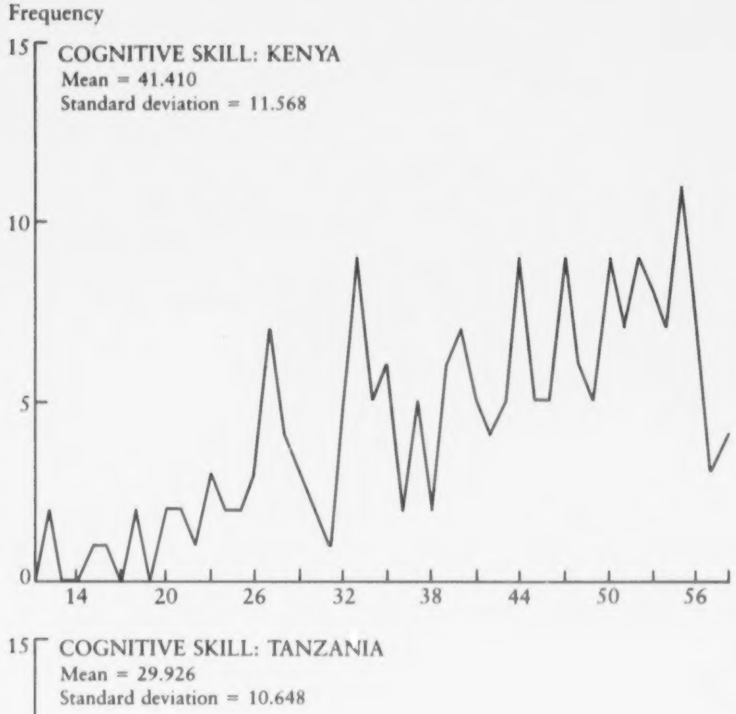

Frequency
15
10
5
0
COGNITIVE SKILL: KENYA
Mean = 41.410
Standard deviation = 11.568
14
20
26
32
38
44
50
56
15
10
5
0
COGNITIVE SKILL: TANZANIA
Mean = 29.926
Standard deviation = 10.648
14
20
26
32
38
44
50
56
Score

Figure 3-3. *Sample and Subsample Wage Distributions, Primary and Secondary Completers*

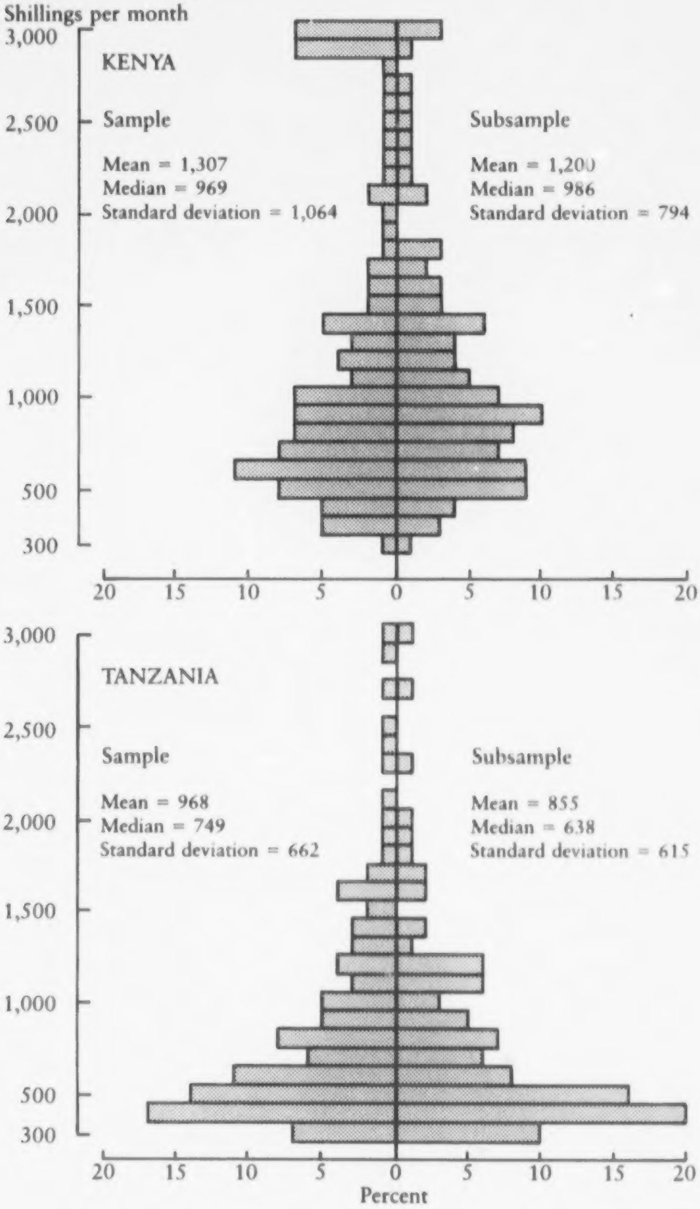


Table 3-1. *Test Scores by Educational Level*

Country and educational level	*Ability (R)*	*Cognitive skill (H)*	*Literacy*	*Numeracy*
Kenya				
Primary	25.14	32.38	16.23	15.51
	(7.22)	(11.52)	(6.22)	(6.43)
Secondary	30.28	46.15	23.21	22.77
	(5.45)	(8.28)	(3.91)	(5.76)
Total	27.78	39.90	19.87	19.47
	(6.86)	(12.02)	(6.21)	(7.06)
Tanzania				
Primary	24.90	24.56	13.93	10.64
	(6.81)	(7.22)	(4.52)	(4.00)
Secondary	29.03	37.31	19.20	18.11
	(6.33)	(10.38)	(5.57)	(6.17)
Total	26.51	29.55	15.99	13.60
	(6.91)	(10.60)	(5.57)	(6.15)

Note: Standard deviations are in parentheses.

the mean value of cognitive skill is distinctly higher for secondary completers, and the percentage by which the secondary score exceeds the primary score is similar. When cognitive skill is separated into its two components, similar results are again obtained, with the exception of the larger percentage difference for numeracy in Tanzania. The mean value of reasoning ability is also higher for secondary completers in both countries, a result which, we shall argue, reflects the selection of the more able children for secondary education. On aggregating the two educational categories we find that the mean ability scores are almost identical in the two countries. There is, however, a marked difference in achievement scores, which reflects, among other things, the higher proportion of secondary completers in the wage labor force in Kenya.

Although our measures of cognitive skill and reasoning ability represent a distinct advance, their potential limitations should be recognized in the interpretation of the estimated model to come. These limitations could produce a biased picture of the effects on earnings of natural ability and of human capital acquisition in school. Because secondary schools select entrants partly on the basis of performance in primary-leaving examinations, the difference between primary and secondary completers in mean achievement scores may exaggerate the value added by secondary education. Our test of whether selection for secondary school on the basis of cognitive achievement qualifies our assumption of recursiveness proved negative, however (see the discussion in "The Educational Production and Attainment Functions and Indirect Effects on Earnings," below). Noncognitive traits, such as attitudes and interests, may also be acquired in school and may be valued in the labor market. Natural ability may involve not only reasoning power but also such unmeasured but marketable qualities as drive, determination, and dynamism. Finally, the ability that we measure may not be attributable entirely to heredity and home environment: education may enhance reasoning power. But the weighted mean values of *R* for the subsamples are not significantly different (27.8 in Kenya and 26.5 in Tanzania), whereas those of *H* are significantly different (39.9 and 29.6), on account of the greater quantity and quality of secondary education in Kenya (see chapter 4). This suggests that *R* is not acquired in school.

The Expanded Human Capital Earnings Function

Estimates of the conventional human capital earnings function (equation 3-1) for Kenya and Tanzania are shown in column 1 of table 3-2.[4] In Kenya workers are paid a premium of 4.2 percent per year of employment experience, and secondary completers are paid 61 percent more than primary completers. In Tanzania the returns to experience are higher (5.4 percent), but because of Tanzania's vigorously imposed pay policy, the gain from secondary education, although substantial, is lower (32 percent). The Tanzanian government has compressed the structure of wages in the dominant public sector. In the relatively unfettered private sector the premium on secondary education is higher than in the public sector and, indeed, higher than in Kenya. We recognize that the competitive market value of secondary education in Tanzania is greater than our estimates suggest; see chapter 6.

Do Cognitive Skill and Ability Matter?

Column 2 of table 3-2 permits a comparison of estimates of the conventional and expanded human capital earnings functions. In neither Kenya nor Tanzania are the estimated returns to experience affected by the introduction of variables that measure (cognitive) achievement and (reasoning) ability. By contrast, the premium on secondary education declines by nearly two-thirds in both countries, and in Tanzania it is no longer significantly different from zero. In neither country is the independent influence of ability on earnings either large or significant. By contrast, in both countries the coefficient on the achievement score is positive, significant, and large in relation to the coefficient on the ability score. This result holds when either the literacy or the numeracy score replaces the combined score.

Table 3-2. *Human Capital Earnings Functions with and without Measures of Ability and Cognitive Achievement*

Country and variable	*Whole subsample (1)*	*Whole subsample (2)*	*Primary completers (3)*	*Secondary completers (4)*	*Manual workers (5)*	*White-collar workers (6)*
Kenya						
L	0.042	0.045	0.031	0.062	0.036	0.049
	(8.40)	(9.84)	(4.49)	(10.20)	(6.02)	(8.64)
S	0.476	0.192	—	—	0.065	0.030
	(6.70)	(2.47)			(0.650)	(0.23)
H	—	0.020	0.019	0.023	0.013	0.017
		(6.18)	(3.98)	(5.40)	(3.21)	(3.55)
R	—	0.006	0.000	0.014	0.003	0.011
		(1.32)	(0.02)	(2.17)	(0.50)	(1.46)
Constant	6.297	5.459	5.811	5.171	5.866	5.705
$\bar{R}^2$	0.29	0.44	0.39	0.50	0.32	0.49
N	205	205	71	134	116	88
Tanzania						
L	0.054	0.055	0.049	0.066	0.044	0.061
	(9.70)	(10.10)	(7.13)	(7.06)	(4.88)	(7.82)
S	0.280	0.112	—	—	0.141	0.068
	(4.30)	(1.42)			(0.85)	(0.58)
H	—	0.013	0.009	0.013	0.008	0.012
		(3.22)	(1.66)	(2.29)	(1.16)	(2.25)
R	—	0.001	− 0.001	0.010	− 0.004	0.013
		(0.15)	(0.21)	(1.01)	(0.64)	(1.51)
Constant	6.067	5.752	5.908	5.476	5.027	5.423
$\bar{R}^2$	0.38	0.43	0.34	0.47	0.24	0.46
N	179	179	107	72	87	88

— Not applicable.

Note: *L*, employment experience; *S*, secondary education; *H*, cognitive skill; *R*, reasoning ability. The dependent variable is the natural logarithm of the wage, ln *W*. Figures in parentheses are *t*-statistics.

Does Cognitive Skill Matter for Manual as Well as for Nonmanual Workers?

The results of the stratified regressions (columns 3–6 of table 3-2) show that in both countries the payment for cognitive skill is not confined to white-collar workers: manual workers are also rewarded for literacy and numeracy. Although the coefficient on *H* is higher for nonmanual than for manual workers (0.017 as against 0.013 in Kenya and 0.012 as against 0.008 in Tanzania), *F*-tests indicate that in neither country is the difference in the coefficient on *H* significant between occupations. It seems that literacy and numeracy enable mechanics, machinists, and forklift drivers as well as accountants, clerks, and secretaries to do a better job.[5] By contrast, in no case is the coefficient on *R* significant.[6]

Could Cognitive Skill Represent Anything but Human Capital?

Administered wage scales might explain why employers would pay a premium to workers with more years of education even if they were not more productive. Screening for ability might similarly explain such a premium even if the cognitive skill acquired in school had no economic value. Neither of these accounts, however, could also explain why cognitive skill is rewarded within an educational stratum.

Although employers could ascertain the years of education of job applicants, they did not have our achievement test scores to provide them with independent measures of numeracy and literacy. But performance on the national form 4 examination does provide employers with a ready indication of cognitive achievement and ability. There is evidence that in Kenya, where competition for jobs among secondary completers is intense, examination performance is indeed used as a selection criterion. We therefore expect and find a significantly positive relation between examination performance and the starting wage (in a Kenyan earnings function for secondary completers in which the worker's starting wage, in constant prices, is the dependent variable). Similarly, our achievement test score bears a positive and significant relationship to the starting wage in Kenya. If, however, these results reflected the favoring of those who performed well on examinations for reasons of "fairness" or for screening purposes rather than simply for their cognitive skill, we would expect the relation to decline with longer experience. On the contrary, in Kenya achievement as measured by scores on our test is a markedly better predictor of current than of starting wage.[7]

In Tanzania, where secondary completers are in scarcer supply, there is no significant relationship between the starting wage and the score on the secondary-leaving examination or on our achievement test (using the same specification for Tanzania as for Kenya). Yet the current returns to cognitive achievement for secondary completers are positive and significant in both countries. Although employers lack ready equivalent measures of the cognitive skill of primary completers, in both countries the returns to cognitive achievement are of the same order of magnitude for both primary and secondary completers. It would seem that employers discover the cognitive skill of their workers on the job and that they are willing to pay for these skills.

Why Do Secondary Completers Earn More Than Primary Completers?

The coefficients on the independent variables can only suggest their relative importance. This exercise and subsequent exercises provide measures of the relative effects that the independent variables in the earnings function have on the structure and dispersion of earnings. The gross difference in geometric mean wages (G) between primary and secondary completers—24 percent in Kenya and 30 percent in Tanzania—is decomposed by means of a technique taken from the literature on labor market discrimination; Blinder (1973) and Oaxaca (1973a, 1973b) are pioneering examples. (We decompose the differences in geometric mean wages, that is, in antilog mean $\ln W$, because the earnings function has $\ln W$ as the dependent variable.) The earnings of primary completers are determined by the earnings function for primary completers and by their characteristics, represented by the vector Z_p. Thus $W_p = F_p(Z_p)$, and, similarly, $W_s = F_s(Z_s)$ for secondary completers. Where a bar indicates the mean value of a variable,

$$
\begin{aligned}
(3\text{-}5) \qquad G &= \overline{W}_s - \overline{W}_p = F_s(\overline{Z}_s) - F_p(\overline{Z}_p) \\
&= F_s(\overline{Z}_s - \overline{Z}_p) + [F_s(\overline{Z}_p) - F_p(\overline{Z}_p)]
\end{aligned}
$$

The first term of the last expression is the component "explained" by the differences in the mean characteristics of the two groups, and the second term is the "unexplained" component that arises from differences in the constant term and the coefficients of the earnings functions. Alternatively, the decomposition can be based on $F_p(Z_s)$ instead of on $F_s(Z_p)$.

We simulate the effect on the predicted wage of a representative primary completer (with the mean characteristics of his group) of imposing, each in turn, the characteristics of a representative secondary completer. Changing the achievement variable, for instance, raises $\overline{W}_p$ in the proportion $c_{3p}(\overline{H}_s - \overline{H}_p)$. The effect of the difference in length of education is obtained from the unexplained residual in equation 3-5, which reflects group differences in earnings functions. The relative contributions to this premium made by group differences in cognitive skill, ability, years of education, and employment experience are shown in table 3-3.

Secondary completers do not earn more because of differential experience on the job; they have less experience than primary completers—markedly so in Kenya and marginally so in Tanzania. This reflects not only secondary completers' later entry into the labor force but also the expansion of secondary education and its more rapid expansion in Kenya than in Tanzania. Nor does the small difference in ability between the two educational groups explain why secondary completers earn more.

Table 3-3. *The Effect on the Predicted Wage of a Representative Primary Completer of Introducing the Characteristics of a Representative Secondary Completer*

	Mean value		*Change in predicted wage, using primary completer coefficients*			*Change in predicted wage, using secondary completer coefficients*		
			$\Delta\ ln\ \overline{W}_s$			$\Delta\ ln\ \overline{W}_p$		
Country and variable	*Secondary completers* ($\overline{Z}_s$)	*Primary completers* ($\overline{Z}_p$)	*Shillings*	*Percent*	$\Delta\overline{W}_s$	*Shillings*	*Percent*	$\Delta\overline{W}_p$
Kenya								
W	1,141.0	918.0	—	—	—	—	—	—
ln W	7.040	6.822	—	—	—	—	—	—
H	46.3	32.3	0.266	280	30.5	0.322	349	38.0
R	30.3	25.7	0.000	0	0.0	0.064	61	6.6
L	6.4	12.6	−0.192	−194.6	−21.2	−0.384	−429	−46.8
S	—	—	0.143	141.3	15.4	0.215	220	24.0
Tanzania								
W	843.0	649.0	—	—	—	—	—	—
ln W	6.737	6.475	—	—	—	—	—	—
H	37.5	24.7	0.115	79	12.2	0.166	117	18.1
R	29.0	25.0	−0.004	−3	−0.4	0.040	27	4.1
L	7.2	7.5	−0.015	−10	−1.5	−0.020	−13	−2.0
S	—	—	0.165	116	17.9	0.075	51	7.8

—Not applicable.

Note: W, wage. For definitions of other variables, see note to table 3-2. The change in the predicted geometric mean wage of primary or secondary completers as the result of the addition or subtraction of four years of secondary education is derived as a residual (the remaining difference in geometric mean wages of the two groups) after eliminating the differences attributable to differences in mean characteristics.

The percentage change in the geometric mean wage is calculated from the change in ln $\overline{W}$ in a way analogous to the dummy variable in semilogarithmic earnings functions explained by Halvorsen and Palmquist (1980).

The differences between primary and secondary completers in the mean values of *H* and *R* are significant at the 1 percent level in both countries.

Δ ln $\overline{W}_s = C_p(\overline{Z}_s - \overline{Z}_p)$ and Δ ln $\overline{W}_p = C_s(\overline{Z}_s - \overline{Z}_p)$.

The direct returns to ability are so low that giving primary completers the ability levels of secondary completers would increase their earnings by about 0–7 percent in Kenya and 0–4 percent in Tanzania. (In each case the lower end of the range is the estimate yielded by the earnings function for primary completers, whose returns are generally lower, and the upper end is that yielded by the earnings function for secondary completers.)

Giving primary completers four more years of education would, other things being equal, substantially increase their earnings, by 15–24 percent in Kenya and by 8–18 percent in Tanzania. This may reflect credentialism or screening, or it could be the result of unmeasured noncognitive skills acquired in secondary education. Giving primary completers the higher achievement levels of secondary completers would lead to the largest increase in wages—31–38 percent in Kenya and 12–18 percent in Tanzania.

Do High-Achieving Primary Completers Earn More Than Low-Achieving Secondary Completers?

The achievement scores in table 3-4 show substantial variation in cognitive development within educational strata. The average achievement test score of the top third of primary completers is double that of the bottom third in both countries. Among secondary completers the average score of the top third is half again as much as that of the bottom third in Kenya and double that of the bottom third in Tanzania. In both countries the score of the top third of primary completers is roughly equal to that of the middle third of secondary completers. It seems that cognitive skill is not the only basis for access to secondary education.

To estimate the impact on earnings within each educational group of the within-group variance of cognitive achievement, the estimated stratified earnings functions are used to predict earnings for different levels of cognitive achievement. In the case of primary completers

$$\widehat{(\ln W_{pH})}_i = c_{0p} + c_{2p}\bar{R}_p + c_{4p}\bar{L} + c_{3p}H_{pi} \tag{3-6}$$

$$\widehat{(\ln W_{pR})}_i = c_{0p} + c_{3p}\bar{H}_p + c_{4p}\bar{L} + c_{2p}R_{pi} \tag{3-7}$$

where H_{pi} and R_{pi} represent the achievement and ability scores of each primary completer i and a hat indicates a predicted value.

The second column of table 3-4 shows the predicted mean wages of primary and secondary completers with varying levels of achievement but the same levels of ability and experience. Secondary completers who scored in the top third on the achievement test are predicted to earn about 50 percent more than those in the bottom third in Kenya and about 35 percent more in Tanzania; roughly the same percentages apply to primary completers. In both countries, it would seem, how well the individual did in primary or in secondary school had a substantial influence on performance at work. Moreover, the predicted wage of primary completers who scored in the top third is nearly as high as that of secondary completers who scored in the bottom third. In Kenya and Tanzania mere attendance at secondary school is no guarantee of success in the labor market; it is necessary to learn one's school lessons.

Table 3-4. *Predicted Wages of Primary and Secondary Completers, by Level of Cognitive Skill and Reasoning Ability*

	Stratification by achievement (H)		*Stratification by reasoning ability (R)*	
Country and group	*Mean score*	*Mean monthly wage (shillings)*	*Mean score*	*Mean monthly wage (shillings)*
Kenya				
Primary completers				
Bottom third	21.4	623	16.0	806
Middle third	31.2	751	26.0	804
Top third	45.0	978	32.2	803
Bottom 10 percent	13.1	532	10.9	807
Top 10 percent	51.6	1,109	34.0	803
Secondary completers				
Bottom third	36.1	1,036	24.2	1,196
Middle third	47.2	1,333	31.5	1,323
Top third	54.0	1,556	34.9	1,387
Bottom 10 percent	28.1	864	17.4	1,083
Top 10 percent	55.9	1,624	35.3	1,395
Tanzania				
Primary completers				
Bottom third	16.8	598	16.7	651
Middle third	24.6	643	26.1	643
Top third	32.0	689	31.1	639
Bottom 10 percent	11.9	571	9.1	657
Top 10 percent	40.7	747	33.4	637
Secondary completers				
Bottom third	25.6	725	21.4	792
Middle third	37.3	847	29.9	862
Top third	48.5	983	33.8	896
Bottom 10 percent	20.1	681	13.4	732
Top 10 percent	52.6	1,039	35.5	911

Do More Able Primary Completers Earn More Than Less Able Secondary Completers?

There is substantial variation in reasoning ability within the two educational strata (table 3-4). As with achievement, the ability of the top third of primary completers is roughly equal to that of the middle third of secondary completers. In contrast to the variation in achievement, however, variation in ability has no effect on the predicted earnings of primary completers and little on those of secondary completers. Moreover, whereas the ability scores of the ablest 10 percent of primary completers are more than double those of the least able 10 percent of secondary completers, their predicted wages are lower. In neither country is being among the ablest of one's peers a sufficient condition for successful performance in the labor market.

How Much Inequality Is Attributable to Cognitive Skill?

The effects that ability, cognitive skill, or years of education have on the dispersion of earnings may differ in relative importance from their effects on the structure of earnings. The latter effects depend only on the size of the coefficients in the earnings function. The former effects depend, in addition, on the distribution of characteristics among employees and on the location in the distribution of pay of employees with various characteristics.

To measure relative contributions to dispersion we use equation 3-4—written here as $\ln W_i = a + \Sigma_j b_{ij} Z_{ij}$, where Z_{ij} is the set of independent variables ($j = 1 \ldots n$)—to predict the earnings of each employee ($\widehat{W}_i$). Each independent variable (j) is in turn set equal to its mean value, and predicted earnings ($\widehat{W}_{ij}$) are estimated with the use of the set of other characteristics possessed by each employee. Here ($\widehat{W}_{ij}$) represents the predicted value of W for each individual (i) when his endowment of j equals that of all other individuals. The variances of $\widehat{W}_i$ and $\widehat{W}_{ij}$ are calculated, and the contribution of Z_j to the explained variance of earnings is estimated as $\text{var}(\widehat{W}_i) - \text{var}(\widehat{W}_{ij})$. The relative contribution of each individual variable is calculated by expressing its contribution as a percentage of $\Sigma_j [\text{var}(\widehat{W}_i) - \text{var}(\widehat{W}_{ij})]$.[8] In effect, we are attempting to answer the counterfactual question, what would be the effect on the inequality of pay if, while mean earnings were held constant, the dispersion attributable to a particular characteristic, such as cognitive achievement, were eliminated?

The relative contribution to inequality of each independent variable in the expanded human capital earnings function for the unstratified sample is shown in table 3-5. The contribution of employment experience to the variance of earnings is markedly greater in Tanzania than in Kenya. In Tanzania mean experience rises monotonically, from 3.1 years in the lowest earnings quintile to 12.1 years in the highest. That is not the case in Kenya, where high levels of experience are associated with low as well as with high incomes, possibly because of the inverse correlation between education and experience: the more educated, who are more plentiful in Kenya, have received preference in access to jobs over the more experienced but less educated. The contribution of the ability variable to the variance of earnings is small in both countries, partly because of its negli-

Table 3-5. *Workers' Mean Characteristics, by Earnings Quintile, and the Relative Contributions of Workers' Characteristics to the Dispersion of Earnings*

	Mean characteristics				*Relative contributions*				
Item	$\bar{L}$	$\bar{S}$	$\bar{H}$	$\bar{R}$	*L*	*S*	*H*	*R*	*Total*
Kenya									
Earnings quintile									
Lowest	6.45	0.43	31.69	25.32	—	—	—	—	—
Second	8.64	0.45	38.00	27.57	—	—	—	—	—
Third	6.62	0.78	44.60	29.71	—	—	—	—	—
Fourth	7.73	0.70	43.82	29.80	—	—	—	—	—
Highest	13.28	0.74	46.61	29.21	—	—	—	—	—
Contribution to variance									
Absolute	—	—	—	—	0.031	0.011	0.049	0.006	0.097
As percentage of total	—	—	—	—	32.0	11.3	50.5	6.2	100.0
As percentage of restricted total	—	—	—	—	—	16.7	74.2	9.1	100.0
Tanzania									
Earnings quintile									
Lowest	3.16	0.23	26.00	25.41	—	—	—	—	—
Second	5.73	0.38	28.98	25.14	—	—	—	—	—
Third	7.68	0.38	29.43	27.60	—	—	—	—	—
Fourth	8.69	0.32	27.56	26.10	—	—	—	—	—
Highest	12.07	0.61	36.16	27.54	—	—	—	—	—
Contribution to variance									
Absolute	—	—	—	—	0.095	0.011	0.025	0.001	0.132
As percentage of total	—	—	—	—	72.0	8.3	18.9	0.8	100.0
As percentage of restricted total	—	—	—	—	—	29.8	67.6	2.7	100.0

— Not applicable.

Note: For definitions of variables, see note to table 3-2.

gible coefficient and partly because high and low earners have similar ability scores. The contribution of years of education is larger, reflecting the size of its coefficient and the tendency for the proportion with secondary education to rise with earnings quintile. In Kenya achievement accounts for three-quarters of the variance in earnings explained jointly by ability, education, and achievement; in Tanzania the share is two-thirds. Not only is cognitive skill highly rewarded, but there are few highly literate and numerate workers, be they primary or secondary completers, in the low-earnings quintiles.

The Educational Production and Attainment Functions and Indirect Effects on Earnings

Having shown that length of education has a relatively small effect on earnings and ability a negligible direct influence, we now examine possible indirect influences through the effects of these factors on cognitive achievement. The simple correlations between *S* and *H* and between *R* and *H* are strong and positive. The mean achievement scores are significantly higher for secondary than for primary completers (43 percent higher in Kenya and 52 percent higher in Tanzania), and there is a monotonic relationship between ability groups and their mean levels of achievement.

The educational production function (from equation 3-3) is presented in table 3-6 with the use of linear and log linear specifications. In both countries cognitive achievement bears a highly significant positive relationship to educational level and to ability. In Kenya secondary education (*S*) raises *H* by 11.75 points (linear form), or by 44 percent (log linear form); similar results are obtained for Tanzania. The elasticity of response of cognitive skill to reasoning ability (*R*) is roughly one-third in both countries. In Kenya the coefficient on *G* (a dummy variable that takes a value of 1 if the secondary school attended by a secondary completer or the primary school attended by a primary completer was a government school and that takes a value of 0 otherwise) is significantly positive in the linear specification. In both countries the coefficient on *B* (a dummy variable that is 1 for birth in an urban area and 0 for birth in a rural area) is almost significantly negative in the linear specification. (This counterintuitive result may reflect greater selectivity in access to schooling and to the urban labor market among the rural-born, who face stiffer competition.)[9]

An educational attainment function (from equation 3-2) was estimated by means of probit analysis. The results are very similar in Kenya and Tanzania, respectively:

Table 3-6. *Educational Production Functions*

	Kenya		*Tanzania*	
Variable	*Linear*	*Log linear*	*Linear*	*Log linear*
S	11.754	0.368	10.939	0.362
	(8.50)	(8.25)	(8.84)	(7.37)
G	3.366	0.061	0.995	0.003
	(2.49)	(1.38)	(0.76)	(0.05)
B	−3.567	−0.065	−2.651	−0.058
	(1.78)	(1.00)	(1.82)	(0.98)
R	0.560	—	0.487	—
	(5.55)		(5.58)	
$\ln R$	—	0.298	—	0.345
		(4.12)		(5.21)
Constant	15.49	2.41	12.34	2.08
$\bar{H}$	39.98	—	30.33	—
$\overline{\ln H}$	—	3.63	—	3.34
$\bar{R}^2$	0.42	0.36	0.44	0.36
Standard error	8.77	0.29	7.76	0.31
Percentage standard error	21	29	26	31

— Not applicable.

Note: G, government school; B, urban birth. For definitions of other variables, see note to table 3-2. The dependent variable is H (linear) or $\ln H$ (log linear). Figures in parentheses are t-statistics.

The mean values of variables, here and elsewhere, are derived from the subsamples weighted according to the proportions in which primary and secondary completers are found in the full samples.

$$\begin{aligned}
\hat{p} &= \Phi(-1.816 + 0.049R + 0.070E + 0.184F_1 + 0.530F_2) \\
&\qquad (4.051) \quad (3.075) \quad (3.918) \quad (0.752) \quad (1.975) \quad \chi^2 = 46.54 \\
\hat{p} &= \Phi(-1.760 + 0.067R - 0.248E + 0.133F_1 + 0.929F_2) \\
&\qquad (3.357) \quad (3.889) \quad (2.484) \quad (0.515) \quad (3.426) \quad \chi^2 = 30.92
\end{aligned}$$

where $\hat{p}$ is the probability of going on to secondary school, E is the number of secondary places as a proportion of the number of 14-year-olds when the respondent was age 14, F_1 indicates that one parent had received education and F_2 that both had received education, $\Phi(.)$ denotes the cumulative unit normal distribution, and the figures in parentheses are t-statistics. The probability of going on to secondary school is positively and significantly related to the ability score. It is significantly higher if both parents are educated and is significantly affected by the secondary enrollment ratio—positively, as expected, in Kenya but negatively in Tanzania. The reason for the negative sign in Tanzania is that although E

rose over time, the proportion of primary completers who went on to secondary school actually fell. With all independent variables at their mean values, an increase in the ability score from the mean of the bottom third to that of the top third would raise the probability of secondary school attendance by 0.25 in Kenya and by 0.35 in Tanzania. Ability therefore has two indirect effects on earnings, not only via relation D but also via relation E in figure 3-1.

Before combining the three functions for simulation analysis, we test whether the estimated model is recursive—that is, whether the estimates are consistent and not subject to simultaneous equation bias. If some unmeasured characteristics, such as drive and determination, contributed to educational attainment, cognitive skill, and earnings, the error terms (v, y, and z, respectively) in equations 3-2, 3-3, and 3-4 would be correlated, as would educational attainment and y, educational attainment and z, and cognitive skill and z. We apply a specification test developed by Hausman (1978) and add the predicted value of educational attainment ($\hat{S}$) for each individual as an independent variable in equations 3-3 and 3-4 and the predicted value of cognitive skill ($\hat{H}$) as an independent variable in equation 3-4. (S and H are generated with the use of equations 3-2 and 3-3, respectively, plus the other exogenous variables in the three-equation system; the linear form of equation 3-3 is used.) The coefficients are not significantly different from zero in five of the six cases and are just significantly so in the sixth. These findings support the null hypothesis that the equation system is recursive.[10]

As a further test of recursiveness between equations 3-2 and 3-3, we estimate equation 3-3 in the linear form with the use of instrumental variables and use the estimated coefficients to generate $\hat{H}$ for each individual at the end of primary school (that is, with $S = 0$). Equation 3-2 is then estimated with $\hat{H}$ as an additional independent variable. The coefficient on $\hat{H}$ is not significant in either country, which suggests that simultaneity on account of selection for secondary school on the basis of cognitive achievement is unlikely. The coefficient was actually negative, being −0.090 (standard error = 0.053) in Kenya and −0.063 (0.079) in Tanzania.

In table 3-7 the indirect effects of ability are measured and compared with the direct effects. Two ability levels are considered in each sample, corresponding to the mean values of R for the top and bottom thirds; all other characteristics of the sample are kept at their mean values. Within the three-equation system we then trace the difference in predicted wages between the two ability levels that is attributable to relations C, D, and E in figure 3-1. The full consequence (incorporating all three effects) of the assumed difference in ability is to create a difference in predicted wages equal to 32 percent of the sample mean in Kenya and 16 percent in Tanzania. The direct effect on earnings of differences in

Table 3-7. *The Direct and Indirect Effects of Ability on Earnings*
(mean values for the top and bottom terciles, classified by reasoning ability)

Country and level	$\hat{H}$ (all effects)				Predicted wages[a] showing effect[b] of:				
	R	$\bar{p}$	Linear	Log linear	Relation C	Relation D	Relation E	Relation E'[c]	Relation C, D, and E[d]
Kenya									
Top third	33.8	0.77	45.8	43.7	1,064	1,089	1,127	1,076	1,250
Bottom third	19.8	0.52	34.9	34.0	979	929	1,012	1,014	881
Difference									
Absolute	14.0	0.25	10.9	9.7	85	160	115	62	369
As percentage of total[e]	—	—	—	—	20	38	27	15	100
Tanzania									
Top third	33.3	0.54	34.7	32.3	749	772	765	754	804
Bottom third	18.5	0.19	23.7	23.3	739	704	700	718	661
Difference									
Absolute	14.8	0.35	11.0	9.0	10	68	65	36	143
As percentage of total[e]	—	—	—	—	6	38	36	20	100

— Not applicable.

Note: $\hat{H}$, predicted value of cognitive skill; R, reasoning ability; p, probability of attending secondary school.

a. The linear specification of equation 3-3 is used.

b. The measure of each effect is derived from equations 3-2, 3-3, and 3-4. It shows the effect on the wage of replacing the mean value of ability for the subsample ($\bar{R}$) with the mean value of the upper or lower third ($\bar{R}_t$). The multiplicands are: relation C, c_2; relation D, $c_1 \cdot b_1$; relation E, $c_1 \cdot \hat{p}\,(a_1) + c_1 \cdot \hat{p}\,(a_1) \cdot b_2$; relation E', $c_1 \cdot \hat{p}\,(a_1) \cdot b_2$; relations C, D, and E, $c_2 + c_1[b_1 + \hat{p}\,(a_1) \cdot b_2] + c_1 \cdot \hat{p}\,(a_1)$. For instance, in the case of relation C, $(\overline{\ln W})_t - (\overline{\ln W}) = c_2(\bar{R}_t - \bar{R})$.

c. Human capital only.

d. All effects.

e. As the sum of the separate effects is not exactly equal to their combined effect, each is expressed as a percentage of the sum.

ability (working through the earnings function alone) accounts for only a fifth of the predicted full wage difference in Kenya and for much less in Tanzania (relation C). The indirect effect of ability on the acquisition of cognitive skill and hence on earnings represents 38 percent in both countries (relation D), and the indirect effect of ability through educational attainment accounts for about a third (relation E). At least half of this effect works through human capital acquisition (relation E') rather than through credentialism.

It is also possible to distinguish the different effects on earnings of secondary school attendance. The directly observed effect (relation B) is derived from the coefficient c_1 in equation 3-4. The value is 0.19 in Kenya and 0.11 in Tanzania, which implies that the wage is raised by 21 and 12 percent, respectively, by credentialism. The other effect (relations F and A) is derived from a combination of equations 3-3 and 3-4. The coefficient b_2 in the former shows the effect of secondary schooling on cognitive skill, and the coefficient c_3 in the latter shows the effect of cognitive skill on earnings. Their product, $b_2 \cdot C_3$ (0.22 in Kenya and 0.14 in Tanzania), indicates that human capital acquisition in secondary school raises earnings by 25 and 15 percent, respectively. The human capital effect of a secondary education thus exceeds the credentialist effect. Thus use of the three-equation system has shown that the indirectly measured effects of differences in reasoning ability and in educational attainment both exceed the direct effects.

Conclusions

Our survey data from Kenya and Tanzania have permitted a sharper test than hitherto of the competing explanations—credentialism, ability, screening, or human capital—of why workers with secondary education earn more than those without secondary education. The direct returns to reasoning ability in the labor market are small, those to years of education are moderate, and those to literacy and numeracy—which are dimensions of human capital—are large. The returns to cognitive achievement are not significantly lower for manual than for nonmanual workers.

The returns to cognitive skill cannot but be a payment for human capital. The direct returns to years of education, however, could reflect credentialism, screening, or human capital acquired at school or at home; that is, their interpretation is inconclusive. It appears that literate and numerate workers are more productive and that education is valuable to workers because it can give them skills that increase their productivity. These conclusions have generally satisfied the usual statistical tests. Their robustness derives no less from the fact that they all apply to both Kenya and Tanzania.

The main effects of length of education and reasoning ability on earnings are indirect, as these factors operate through the development of cognitive skill. Longer-educated or brighter workers tend to be more literate and numerate. The main reason why secondary completers earn more on average than primary completers is their higher average level of cognitive achievement. There is substantial variation, however, in cognitive achievement and in reasoning ability within the two educational groups. Whereas primary completers of high ability earn less than less able secondary completers, primary completers with high cognitive skill actually earn more than less skilled secondary completers. Within each educational group high achievers earn a great deal more than low achievers. Just as cognitive achievement is the main determinant of the structure of earnings, it also accounts for much of the inequality of earnings among workers, far more than do reasoning ability and school attendance. Because inequality is primarily attributable to differences in productivity that arise from differences in cognitive skill, the efficiency cost of reducing inequality may be high.

Our analysis provides strong support for the human capital interpretation of the educational structure of wages. Whether these conclusions should be generalized beyond Kenya and Tanzania to the many other countries for which rates of returns have been estimated is open to question. Kenya and Tanzania have much lower incomes, and cognitive skill is in shorter supply, than in most developing countries, particularly those of Asia and Latin America. As economic development proceeds, the growth of enrollment may outstrip the growth of the economy. In that case the returns to cognitive achievement may decline, whereas for political and institutional reasons the returns to years of education may remain high.

Notes

1. See Psacharopoulos (1973, 1981) for a listing of the estimates obtained from rate of return studies in forty-four countries.

2. See, for instance, Arrow (1973), Blaug (1976), Bowles and Gintis (1976), Riley (1979), Spence (1976), and Thurow (1975).

3. For attempts to control for ability or for cognitive achievement in studies for the United States, see Behrman and others (1980), Chamberlain and Griliches (1977), Griliches and Mason (1972), Olneck (1977), Taubman (1975), Taubman and Wales (1974), and Wise (1975); see also the survey articles by Griliches (1977, 1979). In most instances the data refer to special subgroups in the population, and a clear distinction cannot be made between natural ability and cognitive skill acquired in school.

4. The equations were also estimated with a squared experience term, but whereas the coefficient was negative as expected, it was not significantly different from zero.

5. In only one of the four cases, that of manual workers in Tanzania, is the coefficient on achievement not significant at the 5 percent level.

6. When the samples are stratified instead by educational levels, F-tests indicate precisely equivalent results for the achievement variable. The effect of ability on earnings remains small in comparison with the effect on achievement, and it is not significantly different from zero in three of the four cases.

7. The substitution of ln starting wage for ln current wage as the dependent variable in column 2 of table 3-2 results in a reduction in the coefficient on H from 0.020 to 0.011. That is, the percentage response of current wage to a unit increase in H is nearly twice as great as that of starting wage.

8. For further explication of this method of decomposing inequality and a comparison with other methods, see Behrman, Knight, and Sabot (1983).

9. The log-linear specification (with the continuous variables H and R in natural logarithms) gave similar results but was inferior in terms of the percentage standard error of H (29 percent in Kenya and 31 percent in Tanzania) and the significance of some coefficients. The ensuing simulation analysis is based on the linear specification, but the results are not sensitive to the choice of specification.

10. The coefficients are, respectively, −1.518 (0.373), −0.058 (0.210), and −0.011 (0.748) in Kenya and 4.243 (1.430), 0.433 (2.036), and −0.011 (0.647) in Tanzania. (The figures in parentheses are t-statistics.) The possibility of simultaneity between equations 3-2 and 3-4 in Tanzania makes the Tanzanian results less reliable. But the coefficient on S is significantly positive, which implies that it is biased downward. This suggests that the bias is not attributable to simultaneity.

CHAPTER 4

Why the Returns to Experience Increase with Education

IN CHAPTER 3 WE ASSESSED the alternative hypotheses concerning the positive relationship between education and earnings. Throughout the analysis we standardized for employment experience; that is, we assumed that wages increase with employment experience at the same rate for both primary and secondary completers. In quite a few countries, however, a positive relationship between educational attainment and the returns to employment experience has been observed with the aid of earnings functions.[1] It is therefore possible that a substantial proportion of the gross returns to secondary education is accounted for by this difference in the returns to experience of educational groups. If the reason for the interaction between education and the returns to experience were independent of human capital accumulation, we would have to qualify the conclusions of chapter 3.

The tendency for the earnings-experience profile to be steeper for the more educated is open to competing explanations. Human capital theory provides an explanation, but so do screening and credentialism. Which explanation prevails is important for estimating the social returns to schooling and hence for policy. In this chapter we employ our unique micro data sets to measure the relationship between education and the returns to experience and to subject the human capital interpretation of the relationship to a simple but persuasive test.

The following section uses earnings functions to measure the relationship between the educational level of employees and the slope of the experience-earnings profile. That relationship is shown to be strongly positive. Subsequent sections discuss alternative models of the economic behavior that gives rise to this relationship, present simple simulations as a means of assessing the implications of the human capital hypothesis and the screening and credentialist hypotheses for the rate of return to secondary schooling, specify the test used to adjudicate between the competing hypotheses, and present the results.

Earnings-Experience Profiles

We return to our basic human capital earnings function:

$$\ln W = f(S, L, L^2) \tag{4-1}$$

Column 1 in table 4-1 presents the estimates of such a function for Kenya and Tanzania. (The coefficient on the square of employment experience, L^2, proved not to be statistically significant and was therefore deleted from the estimates based on equation 4-1.) As before, our sample includes only primary and secondary completers; S is a dummy variable that signifies completion of the secondary cycle, and completers of the

Table 4-1. *Human Capital Earnings Functions*

	Conventional human capital earnings function			*Expanded human capital earnings function*	
Country and variable	*Whole subsample (1)*	*Primary completers (2)*	*Secondary completers (3)*	*Primary completers (4)*	*Secondary completers (5)*
Kenya					
S	0.476	—	—	—	—
	(6.70)				
L	0.042	0.035	0.053	0.031	0.062
	(8.40)	(4.64)	(7.79)	(4.49)	(10.20)
R	—	—	—	0.000	0.014
				(0.02)	(2.17)
H	—	—	—	0.019	0.023
				(3.98)	(5.40)
Constant	6.30	6.39	6.70	5.811	5.17
$\bar{R}^2$	0.29	0.23	0.31	0.39	0.50
N	205	71	134	71	134
Tanzania					
S	0.280	—	—	—	—
	(4.30)				
L	0.055	0.049	0.063	0.049	0.066
	(9.70)	(7.09)	(6.62)	(7.13)	(7.06)
R	—	—	—	−0.001	0.010
				(0.21)	(1.01)
H	—	—	—	0.009	0.013
				(1.66)	(2.29)
Constant	6.07	6.11	6.28	5.91	5.48
$\bar{R}^2$	0.38	0.32	0.39	0.34	0.47
N	179	107	72	107	72

— Not applicable.

Note: S, secondary education; L, employment experience; R, reasoning ability; H, cognitive skill. Figures in parentheses are t-statistics.

primary cycle are the base. As expected, the coefficients on the two independent variables, S and L, are positive, large, and highly significant in both countries.

In columns 2 and 3 the sample is stratified to determine whether the returns to experience vary by educational level. In Kenya the increment to earnings per year of employment experience is 51 percent higher for secondary than for primary completers, and in Tanzania it is 29 percent higher. Estimation (not shown) of an interactive specification, $\ln W = f(S, L, S \cdot L)$, of the earnings function confirmed that the difference in returns to experience between educational levels is significant at the 1 percent level in Kenya and at the 10 percent level in Tanzania.

We present again the expanded human capital earnings function

$$\ln W = f(S, L, L^2, R, H) \tag{4-2}$$

but in its stratified form:

$$\ln W = f(L, L^2, R, H) \tag{4-3}$$

Primary and secondary completers are heterogeneous in that within both groups there is substantial variance in reasoning ability and in cognitive achievement.[2] The expanded earnings function can show whether this heterogeneity matters to earnings and, if so, whether taking account of it alters the relationship between education and the returns to experience. It is possible that the observed positive relationship is merely a statistical artifact that arises from omitted variable bias.[3]

Columns 4 and 5 present the estimates of the expanded human capital earnings function. (Again, the coefficient on L^2 proved not to be statistically significant and was therefore deleted from the estimates based on equations 4-2 and 4-3.) For both countries the coefficients on the ability variables are small and not statistically significant in the regressions for primary and for secondary completers. The coefficients on cognitive achievement are large and positive in all four cases and are significant at the 1 percent level in three of the four cases. The positive association between educational level and the returns to experience is not diminished by the inclusion of the ability and achievement variables. Indeed, the difference in returns to experience for primary and for secondary completers is actually larger with this specification than with the conventional one. Estimation (not shown) of an interactive specification, $\ln W = f(E, L, R, H, E \cdot L, E \cdot R, E \cdot H)$, of the expanded human capital earnings function again confirmed the statistical significance, at the 1 percent level in Kenya but at the 10 percent level in Tanzania, of the difference in returns to experience between educational groups. (The coefficients on the $E \cdot R$ and $E \cdot H$ terms were not significant.)

Competing Hypotheses

What is the explanation for the strong positive relationship between educational attainment and returns to employment experience that is observed in Kenya and Tanzania? The following system of equations, an expansion of the system used in chapter 3, illustrates the alternatives:

$$E = a_0 + a_1R + a_2F + u_1 \tag{4-4}$$

$$T = b_0 + b_1R + b_2F + b_3H + u_2 \tag{4-5}$$

$$H = c_0 + c_1E + c_2R + u_3 \tag{4-6}$$

$$V = d_0 + d_1T + d_2R + d_3H + u_4 \tag{4-7}$$

$$\ln W = e_0 + e_1H + e_2V + e_3Q + e_4R + u_5 \tag{4-8}$$

where

H = cognitive skill acquired in school
V = vocational and other skills acquired in postschool training
Q = seniority on the job
E = years of schooling
R = reasoning ability
T = extent of postschool training
F = an indicator of parents' education
u = error terms

Equations 4-4 and 4-5 are educational and training attainment functions, equations 4-6 and 4-7 are educational and training production functions, and equation 4-8 is an earnings function. Although L is central to our empirical analysis, it does not appear in these equations but may act as a proxy for V or Q.

The Human Capital Explanation

Complementarity between investments in schooling and in postschool training can explain why the returns to experience are higher among the more educated. The linkages are as follows:

$$\frac{\partial H}{\partial S} > 0; \quad \frac{\partial T}{\partial H} > 0; \quad \frac{\partial V}{\partial T} > 0; \quad \frac{\partial V}{\partial H} > 0; \quad \frac{\partial \ln W}{\partial V} > 0$$

The more education a worker has received, the greater will be his cognitive skill. The more cognitive skill he has acquired, the greater will be the vocational skills acquired in the course of his working life, both because he is likely to devote more time to training and because his higher level of cognitive skill permits him to derive more from any given training period. (Where training opportunities are rationed by meritocratic criteria, he is more likely to be selected for training programs; where a price rationing system is in effect, he is likely to demand more training because, owing to his greater H, the expected returns are higher.) The greater the accumulation of vocational skills, the steeper will be the worker's earnings-experience profile, at least initially. This is, in essence, the explanation given by Mincer (1974, p. 30): "So long as gross investment extends over the working life and retirement age is not earlier for the more educated, [the postschool investment ratio for the more educated] is likely to exceed [the ratio for the less educated] at each age. This is the simplest interpretation of the universally observed divergence ('fanning out') of age profiles of earnings."

The Screening and Self-Selection Explanations

Mincer (1974, p. 131) recognized that evidence of a positive relationship between levels of investment in schooling and in postschool training "is consistent with a notion of complementarity between the two investment forms, but does not constitute a proof." There could be an association between the two types of investment simply because they have a determinant in common; ability could be one such determinant:

$$\frac{\partial S}{\partial R} > 0; \quad \frac{\partial V}{\partial R} > 0; \quad \frac{\partial \ln W}{\partial V} > 0$$

The higher the individual's ability, the more education he is likely to receive, either because schools apply meritocratic selection criteria or because the private benefits of continuing education are greater. Also, the higher the individual's ability, the greater the skills acquired in training, because he is likely to devote more time to training (employers may select for training directly on the basis of ability or they may use educational attainment to screen for ability) and because he can derive more from any given training period. The greater are the skills acquired in training, the steeper, at least initially, is the earnings-experience profile. In this case there will be a positive relation between education and returns to experience even if skills acquired in school do not increase the skills acquired in training (that is, $\partial V/\partial H = 0$).

Family background could be another determinant of both educational attainment and training; for example, high-income families are better able to afford both types of expenditure.

$$\frac{\partial S}{\partial F} > 0; \quad \frac{\partial V}{\partial F} > 0; \quad \frac{\partial \ln W}{\partial V} > 0$$

Again, even if $\partial V/\partial H = 0$, there would be an association between educational level and the returns to experience.

The Credentialist Explanation

This explanation, in contrast to the others, does not posit a relationship between skills acquired in training and earnings. It applies even if $\partial \ln W/\partial V = 0$. The educated have higher returns to experience because they are more likely to be in white-collar jobs and, in the words of Phelps Brown (1977, p. 266), "The possibility of advancing to higher pay by length of service might be regarded as one of the traditional privileges of the white-collared, coming down from the time when their attainments were scarcer than they are now." This implies:

$$\frac{\partial \ln W}{\partial Q} > 0; \quad \frac{\partial e_3}{\partial E} > 0$$

that is, the returns to seniority are positive, and they increase with education irrespective of differences between educational groups in vocational and other skills acquired in the course of their working lives.

Differences in Profiles and Social Returns to Schooling

Human capital earnings functions estimated by means of cross-section data are generally used to measure the returns to schooling. The coefficients on the experience variable in the equations stratified by educational level are used to simulate two time series, $\widehat{W}_p$ and $\widehat{W}_s$, which represent the predicted wages, over their expected working lives, of primary and secondary completers, respectively. For instance, in the case of secondary completers (subscript *s*), from the expanded earnings function estimated in table 4-1,

$$\ln W_s = a_s + b_s L + c_s R_s + d_s H_s + u_s \tag{4-9}$$

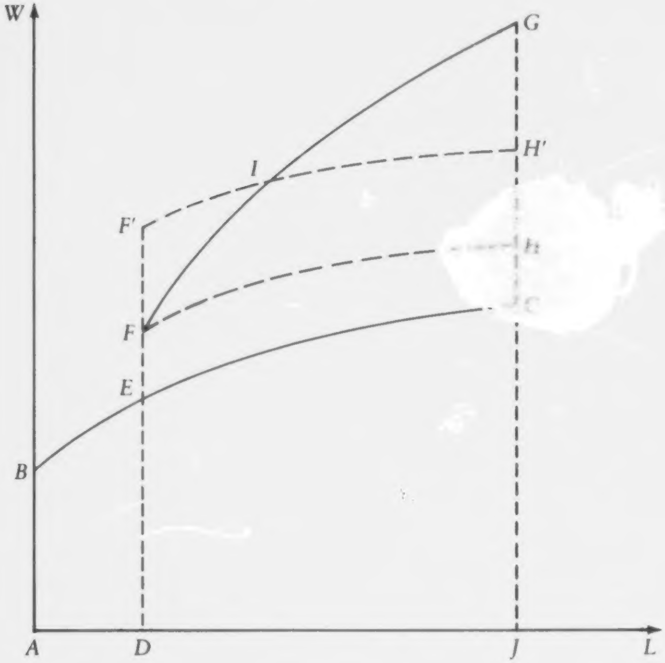
we predict

$$\widehat{\ln W_s} = \hat{a}_s + \hat{b}_s L + \hat{c}_s \bar{R}_s + \hat{d}_s \bar{H}_s \tag{4-10}$$

where a hat indicates the estimated value and a bar the mean value, and similarly for primary completers. The difference between the educational groups in predicted lifetime earnings is then taken as the measure of the social benefit of secondary education. Figure 4-1, a stylized rendering of our results from Kenya and Tanzania, illustrates this point.

The estimate of the social returns to education is not independent of the explanation for the interaction between education and returns to experience. In attempting to measure the social benefit we therefore

Figure 4-1. *Identifying the Social Returns to Education*



BC	Primary completer earnings stream
FG	Secondary completer earnings stream
ABED	Opportunity cost of secondary schooling
CEFG	Gross private benefits of secondary schooling

distinguish between the direct and the interaction effects, that is, the effects that accrue in the absence of interaction between education and the returns to experience and those that are a result of such interaction.

The division between the direct and the interaction effects depends on the interpretation of the latter. If the credentialist interpretation of interaction is correct, for instance, the direct effect is shown by *CEFH* and the interaction effect by *FGH* in figure 4-1. In this case the steeper earnings profile of the more educated arises not from greater skill and productivity but from custom and prejudice, and *FGH* does not represent a social benefit.

In other cases, however, the interaction effect represents the greater postschool skill acquisition of the more educated. Such skill acquisition has to be paid for, either by the employee or by the employer. In the case of general skills the market prediction is that it is the employee who pays and that the payment takes the form of lower initial earnings.[4] In that case the division between the net direct and interaction effects is between *CEF'H'* minus *ABED* and *GH'I* minus *FF'I*. Here *FF'I* represents the cost of skill acquisition borne by the worker and *GH'I* the benefit that he subsequently derives. In perfectly competitive markets the present value of the net benefit, discounted at the appropriate rate of discount, equals zero; in imperfect markets it can be positive but may nevertheless equal the return on alternative investments such as formal education.

Both the human capital explanation of interaction and the screening and self-selection explanations make the distinction between the direct and the interaction effects discussed above. They differ, however, in their analysis of causation. According to the human capital interpretation the additional education is the cause of the additional postschool skills: *GH'I* − *FF'I* is part of the social benefit of secondary schooling. On the screening and self-selection interpretations the additional education, although a positive correlate of the postschool skill acquisition, is not the causal factor: *GH'I* − *FF'I* is not a social benefit attributable to secondary schooling.

In the light of this theoretical analysis we examine two empirical questions. First, how is the direct effect of secondary education to be explained? Second, given that the evidence supports a human capital interpretation of the direct effect, is the social benefit of secondary education sensitive to the interpretation of the interaction effect? We find that the interaction effect is indeed sufficiently large in relation to the direct effect to warrant further analysis.

The interpretation of the direct effect of secondary education in these samples was subjected to detailed analysis in chapter 3, and our tests pointed to a human capital explanation. Support can also be found in the results of table 4-1. From equation 4-10 the difference in predicted mean ln *W* between secondary and primary completers ($\widehat{\ln W_s} - \widehat{\ln W_p}$) can be decomposed, at any assumed value of L, into the contributions of the explanatory variables—the constant term ($\hat{a}_s - \hat{a}_p$), employment experience ($\hat{b}_s L_s - \hat{b}_p L_p$), reasoning ability ($\hat{c}_s \bar{R}_s - \hat{c}_p \bar{R}_p$), and cognitive skill ($\hat{d}_s \bar{H}_s - \hat{d}_p \bar{H}_p$).

Table 4-2 expresses, as a proportion of the total, the difference in predicted ln earnings that is attributable to cognitive skill for those who have no employment experience, those whose predicted earnings equal their actual mean values, and those whose predicted earnings equal their mean earnings potential before postschool acquisition of skills (derived by means of Mincer's "overtaking point"; see Mincer 1974, p. 17, and discussion below). Whether we assume no employment experience or the actual mean length of employment experience, cognitive skill alone

Table 4-2. *The Contribution of Cognitive Skill to the Difference in Predicted Earnings for Primary and Secondary Completers*
(percent)

Experience	*Kenya*	*Tanzania*
No employment experience[a]	193	176
Mean employment experience[b]	188	103
No postschool skill acquisition[c]	94	75

a. $L_s = L_p = 0$.
b. $L_s = \bar{L}_s, L_p = \bar{L}_p$.
c. $L_s = L_p = L^*$, where L^* is the "overtaking point."

Table 4-3. *The Effect on Present Values of Differences between Primary and Secondary Completers in Returns to Experience*
(thousands of shillings)

	Kenya		*Tanzania*	
Present value	*Human capital[a] earnings functions (1)*	*Expanded human capital[b] earnings functions (2)*	*Human capital[a] earnings functions (3)*	*Expanded human capital[b] earnings functions (4)*
PV_s	313	358	252	258
PV_p	216	210	215	216
PV_s'	225	203	190	185
ΔPV	97	148	37	42
$\Delta PV'$	9	7	−25	−31
$\Delta PV''$	46	33	15	11

Note: Present values are calculated with a discount rate of 5 percent.
a. The predictor equations used are columns 2 and 3 of table 4-1.
b. The predictor equations used are columns 4 and 5 of table 4-1.

accounts for *more* than the total difference in predicted earnings. It accounts for at least three-quarters of the difference in predicted earnings when both the costs and benefits of postschool skill acquisition are eliminated.

To repeat our earlier finding, it is difficult to interpret this contribution of cognitive skill except as showing the minimum influence of human capital acquired in secondary school. The evidence suggests that the direct effect of secondary education represents human capital and confers a social benefit. In the remainder of the chapter, therefore, we concentrate on the interaction effect.

If the credentialist interpretation of the interaction term applies, it is relevant to know whether the estimate of the social return to secondary education is sensitive to the inclusion or exclusion of *FGH*. The simulations presented in table 4-3 provide the basis for an assessment. Columns 1 and 3 show the discounted present values derived by applying the procedure for predicting lifetime earnings described above to the stratified human capital earnings functions presented in columns 2 and 3 of table 4-1. The difference in the discounted present value of earnings between primary and secondary completers ($\Delta PV = PV_s - PV_p$) is the standard measure of the benefits of secondary schooling. Although ΔPV is considerably larger in Kenya than in Tanzania, it is substantial in both countries when a discount rate of 5 percent is used.

The term PV_s' is derived by simulating the earnings stream of secondary completers on the assumption that they had the returns to experience of primary completers, that is, by substituting $\hat{b}_p L_s$ for $\hat{b}_s L_s$ in the human capital equivalent of predictor equation 4-10. Thus $\Delta PV' = (PV_s' - PV_p)$ measures the gross benefits of secondary schooling after the effect of the interaction between education and the returns to experience is subtracted (*DFHJ* − *DECJ* in figure 4-1; ΔPV corresponds to *DFGJ* − *ABCJ* and $\Delta PV'$ to *CEFH*). In both countries there is a marked difference between ΔPV and $\Delta PV'$ (columns 1 and 3): in Kenya the benefit of secondary schooling (in thousands of shillings) drops from 97 to 9, and in Tanzania it falls from 37 to −25.

When the expanded human capital earnings functions (which include the ability and cognitive achievement variables) are used as predictor equations, the results are essentially the same (columns 2 and 4). (Although the present values are, of course, lower, the same pattern of results is obtained when a discount rate of 10 percent is used.) Estimates of the social benefits of secondary schooling are thus highly sensitive to whether the higher returns to experience of secondary completers are interpreted as being attributable to credentialist seniority scales.

It is also possible to examine the sensitivity of the social benefit of secondary education to the alternative assumptions that the interaction is caused by the additional education or is merely correlated with it. According to the human capital interpretation the full area *CEFG* is a measure of the social benefit, whereas in the screening and self-selection explanations only *CEF'H'* is a social benefit attributable to the secondary education. Although the rate of return may be no higher on postschool than on school investment, the absolute return on school investment is greater on the human capital interpretation, provided that the rate of return exceeds the rate of discount—that is, provided that the discounted present value of *GH'I* − *FF'I* is positive.

As an illustration of the sensitivity of present values to these different interpretations, we estimate, by means of Mincer's "overtaking point," the difference in present values that is attributable to the difference between *CEFG* and *CEF'H'* (see Mincer 1974, p. 17). Mincer has argued that on certain fairly strong assumptions an estimate can be made for the earnings potential of school leavers. (The potential is actual earnings plus payment for current skill acquisition minus payment received for previous postschool skill acquisition.) The point at which the actual earnings curve, which rises with experience, overtakes the horizontal earnings potential is given by $j = 1/r$, where j is the overtaking year of experience, r is the rate of return on both school and postschool investment, and it is assumed that the worker pays the same amount for training in each period. For any given value of r there is a value of j that can then be used to identify the earnings potential of both secondary and primary completers. The difference between them is our measure of *CEF'H'*. (In fact, we measure a rectangle corresponding to *CEF'H'*, abstracting from postschool investment at both the secondary and primary levels, rather than *CEF'H'* itself, abstracting from postschool investment at the secondary level only.)

Our illustrative assumption about the value of r is that it equals the combined rate of return to secondary school and to additional postschool investment (as calculated from benefits *CEFG* and costs *ABED*). An estimated r of 13 percent for Kenya and 8 percent for Tanzania implies values for j of 8 years in Kenya and 12 years in Tanzania. The earnings potentials for secondary completers in Kenya and Tanzania are then 12,051 and 10,603 shillings, respectively, and for primary completers, 9,451 and 9,729 shillings. These earnings potential streams are discounted to the primary-leaving point at 5 percent. The difference between them ($\Delta PV''$ in table 4-3) is to be contrasted with our estimate on the human capital interpretation (ΔPV in the table). The discounted present value (in thousands of shillings) of $\Delta PV''$ for Kenya, 46, falls well short of ΔPV, 97; in Tanzania the fall is from 37 to 15. Again, this illustrative exercise suggests that the choice between these interpretations of interaction has a considerable effect on estimates of the social value of secondary education.

The Test of Competing Hypotheses

Our test of the competing explanations for the interaction between education and returns to experience is a simple one. We examine, first, whether there is a positive relationship between the level of cognitive skill and the returns to experience among workers with a given level of education. Second, we try to determine whether the difference in cognitive skill between primary and secondary completers is sufficient to explain their difference in returns to experience.

The human capital explanation posits complementarity between education and training. The output of schooling (cognitive skill) is an input into the postschool skill acquisition process: workers with higher cognitive skill accumulate more vocational skill, and more vocational skill generates higher earnings. This explanation yields the prediction that even among workers with the same educational level, the returns to experience will be higher for those with higher cognitive skill. Furthermore, it implies that the higher returns to experience of secondary completers are attributable to their higher cognitive achievement.

The predictions yielded by the credentialist explanation are distinct from the human capital predictions. Because the returns to experience are tied by institutionally determined wage structures to the educational credential that the individual possesses, secondary completers have the same returns to experience irrespective of their level of cognitive skill. Since the same is held to be true of primary completers, the difference in cognitive skill between the two groups cannot be responsible for the difference in their returns to experience.

The screening and self-selection hypotheses also reject the proposition that education causes training; a third factor—for example, ability or family background—explains why some workers have more of both. This explanation implies that differences in cognitive skill among workers with the same educational level do not give rise to differences in returns to experience. Similarly, any difference in cognitive skill between primary and secondary completers will not cause a difference in returns to experience.

We test for a positive relationship between cognitive skill and the returns to experience by means of the following specification of the expanded human capital earnings function stratified by educational level:

$$\ln W = f(L, R, H, H \cdot L) \tag{4-11}$$

where $H \cdot L$ is an interaction term that measures the returns to experience at various levels of cognitive skill. Estimates of these equations are presented in columns 1 and 2 of table 4-4. They can be compared with the equivalent results (but without the interaction term) in table 4-1. For the secondary stratum in Kenya the addition of $H \cdot L$ reduces the return to experience from 6.2 to 0.6 percent per year of experience. The former estimate is highly significant, the latter not at all. Among secondary completers in Tanzania the return to experience declines from 6.6 to 0.3 percent per year and is no longer significant. At the primary level also, the addition of $H \cdot L$ causes the coefficient on experience to decline and become insignificant in both countries. The coefficient on $H \cdot L$, although positive, is not significant in either country.

Since the L term is insignificant in all four cases, we reestimated the equation without it (columns 3 and 4). The $H \cdot L$ terms are now highly significant in all four cases. For both primary and secondary completers the returns to experience vary positively with their level of cognitive skill. For example, among Kenyan secondary completers with ten years of experience the return to experience is 4.7 percent per year for those

Table 4-4. *Expanded Human Capital Earnings Functions: Interactive Specification*

	Including L		*Excluding L*	
Country and variable	*Primary completers (1)*	*Secondary completers (2)*	*Primary completers (3)*	*Secondary completers (4)*
Kenya				
L	0.026	0.006	—	—
	(1.04)	(0.152)		
R	−0.0005	0.014	0.002	0.014
	(0.063)	(2.17)	(0.230)	(2.17)
H	0.017	0.016	0.009	0.015
	(1.78)	(2.59)	(1.60)	(3.51)
$H \cdot L$	0.0002	0.001	0.001	0.0015
	(0.207)	(1.72)	(9.33)	(10.50)
Constant	5.86	5.49	6.10	5.52
$\bar{R}^2$	0.39	0.51	0.38	0.51
N	71	134	71	134
Tanzania				
L	0.026	0.003	—	—
	(1.02)	(0.095)		
R	−0.001	0.009	0.000	0.009
	(0.141)	(0.951)	(0.045)	(0.954)
H	0.002	0.0001	−0.006	−0.0003
	(0.228)	(0.010)	(0.921)	(0.055)
$H \cdot L$	0.001	0.002	0.002	0.002
	(0.918)	(2.19)	(7.12)	(7.62)
Constant	6.07	5.94	6.25	5.96
$\bar{R}^2$	0.35	0.51	0.34	0.51
N	107	72	107	72

— Not applicable.

Note: For definitions of variables, see note to table 4-1. Figures in parentheses are *t*-statistics.

whose score on our tests of cognitive achievement is at the mean of the bottom third and 9.9 percent per year for those whose score is at the mean of the top third.

The coefficient on $H \cdot L$ estimated for the secondary strata is similar in magnitude to the coefficient estimated for the primary strata; indeed, in Tanzania they are the same (columns 3 and 4). This result suggests that the difference between primary and secondary completers in the returns to experience can be explained by the markedly higher cognitive achievement of secondary than of primary completers: the average premium per year of experience in Tanzania would be the same for primary and secondary completers who had the same employment experience and cognitive skill. Table 4-5 shows the effect of the difference in cognitive skill between primary and secondary completers on the present values of their earnings streams. The predictor equations are:

for PV_s

$$\widehat{\ln W_s} = \hat{a}_s + \hat{b}_s\bar{R}_s + \hat{c}_s\bar{H}_s + \hat{d}_s\bar{H}_s \cdot L_s$$

for PV_p

$$\widehat{\ln W_p} = \hat{a}_p + \hat{b}_p\bar{R}_p + \hat{c}_p\bar{H}_p + \hat{d}_p\bar{H}_p \cdot L_p$$

for PV''_s

$$\widehat{\ln W_s} = \hat{a}_s + \hat{b}_s\bar{R}_s + \hat{c}_s\bar{H}_s + \hat{d}_s\bar{H}_p \cdot L_s$$

for PV''_p

$$\widehat{\ln W''_p} = \hat{a}_p + \hat{b}_p\bar{R}_p + \hat{c}_p\bar{H}_p + \hat{d}_p\bar{H}_s \cdot L_p$$

The difference between primary and secondary completers in present value ($PV_s - PV_p$), in thousands of shillings, is 181 in Kenya and 76 in Tanzania. If secondary completers had the mean cognitive skill of primary completers, insofar as that would influence the returns to experience, the difference in present value ($PV''_s - PV_s$) would decline to 3 in Kenya and to −38 in Tanzania; $PV_s - PV''_p$ is also markedly lower than $PV_s - PV_p$. In both Kenya and Tanzania a substantial part of the difference in the present value of earnings between the two educational groups is attributable to the influence on the returns to experience of the higher cognitive skill of secondary completers. (The same pattern of results is obtained, and this conclusion therefore stands, when a discount rate of 10 percent is used instead.)

A conclusion that this evidence supports a human capital explanation

Table 4-5. *The Effect on Present Values of Differences in Cognitive Skill between Primary and Secondary Completers*
(thousands of shillings)

Present value	*Kenya*	*Tanzania*
PV_s	389	290
PV_p	208	214
PV''_s	211	176
PV''_p	300	389
$PV_s - PV_p$	181	76
$PV''_s - PV_p$	92	−38
$PV_s - PV''_p$	89	−99

Note: Present values are calculated with a discount rate of 5 percent. The predictor equations used are columns 3 and 4 of table 4-4.

of the interaction must be qualified in two respects. First, it is possible that ability and family background enter the production function of both cognitive and vocational skills. In this case we might find some association between cognitive skill and returns to experience among workers of the same educational level despite the absence of a causal relationship. The evidence is consistent with the screening and self-selection explanations of interaction to the extent that the difference between primary and secondary completers in ability or family background explains their difference in cognitive skill.

The relative contributions that secondary schooling and its possible correlates make to cognitive skill acquisition can be examined by means of an educational production function:

$$H = a_0 + a_1 S + a_2 R + a_3 F_1 + a_4 F_2 + u \tag{4-12}$$

where F_1 is a dummy variable indicating that one parent has received education and F_2 is a dummy variable indicating that both parents have received education. Equation 4-12 differs from the educational production function presented in chapter 3 principally in the addition of the family background variables. (The terms representing type of school attended and place of birth are excluded.) The difference between primary and secondary completers in mean cognitive skill has three components:

$$\bar{H}_s - \bar{H}_p = \hat{a}_1 + \hat{a}_2(\bar{R}_s - \bar{R}_p) + \hat{a}_3(\bar{F}_{1s} - \bar{F}_{1p}) + \hat{a}_4(\bar{F}_{2s} - \bar{F}_{2p}) \tag{4-13}$$

The results of this exercise are set out in table 4-6. Possession of secondary education accounts for 83 and 84 percent of the total difference in Kenya and Tanzania, respectively, and differences in reasoning ability account for only 18 and 15 percent. Although reasoning ability is an important input into the educational production function, the difference in ability between primary and secondary completers is very small in both countries. There are large differences in family background, but family background has only negligible positive or negative effects on cognitive skill. (The effect is liable to be underestimated owing to the truncation of our sample, a result of the exclusion of those secondary graduates who continued their schooling. Moreover, family background may have a powerful indirect effect on cognitive achievement because of its influence on the probability of attaining secondary education; see chapter 10.) Our evidence provides more support for the human capital interpretation of the $H \cdot L$ term than for the screening and self-selection explanations.

Elsewhere (Knight and Sabot 1981, which used the 1971 survey of manufacturing employees in Tanzania) we have argued that interaction between education and experience arose partly as a response to the rapid expansion of education in Kenya and Tanzania. The more recent cohorts

Table 4-6. *Educational Production Functions and the Decomposition of Differences in Cognitive Skill*

Item	*Kenya*	*Tanzania*
Coefficients		
S	11.440	10.735
	(8.00)	(8.42)
R	0.548	0.479
	(5.20)	(5.55)
F_1	−0.197	−1.079
	(0.13)	(0.18)
F_2	−1.077	0.168
	(0.66)	(0.12)
Constant	18.545	13.239
$\bar{R}_2$	0.404	0.451
N	204	183
Mean values		
R_s	30.235	28.942
R_p	25.722	24.868
$R_s - R_p$	4.513	4.074
F_{1s}	0.303	0.289
F_{1p}	0.222	0.351
$F_{1s} - F_{1p}$	0.081	−0.062
F_{2s}	0.296	0.464
F_{2p}	0.139	0.228
$F_{2s} - F_{2p}$	0.157	0.236
H_s	46.189	37.606
H_p	32.458	24.816
Decomposition		
$\bar{H}_s - \bar{H}_p$	13.731	12.793
Part attributable to		
$\hat{a}_1$	11.440	10.735
	(83.3)	(83.9)
$\hat{a}_2(\bar{R}_s - \bar{R}_p)$	*2.473*	*1.951*
	(18.0)	*(15.3)*
$\hat{a}_3(\bar{F}_{1s} - \bar{F}_{1p}) + \hat{a}_4(\bar{F}_{2s} - \bar{F}_{2p})$	−0.185	0.265
	(−1.3)	(1.1)

Note: The dependent variable is H. F_1, both parents with no education; F_2, one parent with primary education, one parent with no education. For definitions of other variables, see note to table 4-1. Figures in parentheses beneath coefficients are t-statistics; figures beneath decomposition terms are percentage compositions.

to enter the labor market filtered down into jobs in which their education had less value. Employment experience thus acted as a proxy for year of entry into the labor market, which in turn greatly influenced occupational attainment; hence the positive correlation between years of employment experience and returns to education, which is equivalent to a positive correlation between years of schooling and returns to experience. The more recently entered jobs are likely to reward cognitive skill less—and thus to render the coefficient on $H \cdot L$ positive—when these jobs require less vocational skill or less cognitive skill. We show below that filtering down has occurred in both countries at both educational levels—most markedly at the secondary level in Kenya—and that the educational structure of wages has been compressed as a consequence (see chapter 7).

If the positive coefficient on $H \cdot L$ within educational strata arises because the more recently entered jobs require less vocational skill, it represents the positive effect of cognitive skill on vocational skill acquisition and points to the human capital interpretation of the interaction term. If, however, the positive coefficient arises because the more recently entered jobs require less cognitive skill, it represents a direct but differential effect of cognitive skill on earnings in different occupations. This interpretation provides an independent explanation for both the positive coefficient on $H \cdot L$ within educational strata and the positive interaction between experience and education across strata. A partial test of this explanation can be made by reestimating the expanded human capital earnings functions (corresponding to columns 3 and 4 in table 4-4) for manual and nonmanual subsamples, thus eliminating some of the effect of filtering down. The coefficients on $H \cdot L$ remain positive and significant in each case.[5] This exercise suggests that the second explanation, which is not consistent with the human capital interpretation of interaction between education and experience, is unlikely to be important.

Conclusions

We have shown that returns to employment experience vary positively with educational level and that this interaction accounts for a substantial part of the returns to secondary schooling as conventionally measured. We have also shown that for workers with the same amount of education, returns to experience vary positively with level of cognitive skill and that the difference in cognitive skill between educational levels explains a substantial part of their difference in returns to experience and thus of the returns to secondary education. These findings passed the usual statistical tests. Their robustness is reinforced by the fact that they apply to both countries.

Our results are not consistent with the credentialist interpretation of the interaction between education and returns to experience. They are consistent with the screening and self-selection explanations only to the extent that the difference in ability or family background between primary and secondary completers explains their difference in cognitive skill. We have shown, however, that most of the difference in cognitive skill between the two groups is accounted for by the difference in their years of schooling.

Our findings provide support for the human capital interpretation. More educated workers appear to have higher returns to experience because education and training are complementary: the skills acquired in school are determinants of training attainment and are inputs into the process of postschool acquisition of skills. More skills of one type beget more skills of another. This supports the conventional practice of including among the social returns to schooling that part of the returns that arises from the interaction between education and returns to experience.

Notes

1. See, for example, Blaug (1976), Knight and Sabot (1981), Layard and Psacharopoulos (1974), and Mazumdar (1981). The relationship can equally be seen as one between employment experience and the returns to education.

2. Recall that our estimates of educational production functions in which *H* is the dependent variable indicate that the variance in achievement is in part a result of the differences in ability among respondents. There is evidence that differences in the quality of the school attended and in training received within the home also play a role.

3. Suppose that cognitive skill influences earnings and that, owing to rapid expansion of the school system and a consequent fall in the quality of schools or of pupils, the level of cognitive skill is higher among workers with more experience (who belong to earlier cohorts of school completers) than among the relatively inexperienced recent completers. Omission of *H* from the independent variables in the earnings function then biases upward the coefficient on experience. If the positive relationship between *H* and *L* is stronger among secondary than among primary completers—perhaps reflecting different rates of educational expansion—the upward bias in the returns to experience is then greater in the regression estimated for the secondary stratum.

4. See, for example, Mincer (1974), ch. 1. To the extent that skills are firm-specific, however, the costs are likely to be shared between the employer and the employee; see, for example, Becker (1964) and Oi (1962).

5. They are 0.0009 (3.69), 0.0015 (5.49), 0.0014 (3.20), and 0.0027 (3.49), respectively, for manual occupations and 0.0014 (6.01), 0.0012 (8.03), 0.0025 (4.64), and 0.0019 (6.93) for nonmanual occupations. (The figures in parentheses are *t*-statistics.)

CHAPTER 5

Education Policy and Labor Productivity: An Output Accounting Exercise

THE RELATION BETWEEN EDUCATION and labor productivity in Kenya and Tanzania (chapters 3 and 4) raises the question discussed here: how have differences in the two countries' education policies affected labor productivity? To put the question another way, to what extent does the difference in human capital endowments brought about by differences in education policy regimes account for the observed gap between the two countries in the productivity of wage labor? In 1968 the difference between Kenya and Tanzania in productivity, as indicated by average wages, was only about 10 percent, but by 1980 the difference had grown to roughly 50 percent. The use of an appropriate shadow rate of foreign exchange would increase this estimate.

This chapter takes the output accounting approach, of which Krueger (1968) provides a pioneering example. Krueger used crude aggregate census data from about twenty countries, most of them developing countries, to assess the contribution that differences in educational endowments between countries make to differences in per capita income. From data on income by educational level in the United States she first estimated the effect on U.S. per capita income of assuming, instead of the U.S. educational distribution, the distribution of education in each of the other countries. She then compared the size of this effect with actual differences in per capita income.[1] Krueger explained more than half of the actual difference in per capita income by differences in human capital and concluded that human capital (defined more broadly than educa-

Note: Adapted from J. B. Knight and R. H. Sabot, "Educational Policy and Labour Productivity: An Output Accounting Exercise," *Economic Journal* 97, no. 385 (March 1987), pp. 199–214.

tional attainment) made a greater contribution than all other factors combined.[2]

Both output and growth accounting suffer from well-known drawbacks (see, for instance, the critiques in Bowman 1980 and Nelson 1981). First, failure to take account of the other determinants of income can bias estimates of the difference in income, and therefore in productivity, that is attributable to education. Second, by assuming that the (standardized) earnings difference between educated and uneducated workers simply measures the productivity of education, the output and growth accountants attribute causation to what may be at least in part a noncausal correlation. This effective equating of the marginal products of factors with their remuneration has led some practitioners to regard growth accounting as no more than "a first step which cannot be relied upon to give answers to counterfactual questions" (Matthews, Feinstein, and Odling-Smee 1982, p. 15). Such adjustments as have been made to the earnings difference in estimating the marginal product of education have in general simply attributed an arbitrary proportion of the difference in earnings to "ability" or to other correlates of education.[3] Third, the simulations on these accounting exercises are generally conducted for time periods or economies that differ markedly in the relative supply of and demand for educated labor. The differences that factor endowments and the characteristics of production functions bring about in the structure of factor prices or in their marginal products render unreliable the answers to the counterfactual questions being posed.[4] Krueger (1968, pp. 643–44) claimed that her measure of the contribution of education would yield a minimum estimate, essentially because the marginal product of human capital in the United States would be relatively low if the United States were well endowed with human capital. This would not necessarily be the case, however, if the U.S. economy had a greater relative demand for human capital.[5]

Here we attempt to minimize these drawbacks by examining the natural experiment afforded by Kenya and Tanzania, two countries that have had different education policies but that are similar in relevant respects other than the supply of educated labor. In particular, there is evidence that the relative demand functions for different categories of educated labor are similar in the two economies (see chapters 6 and 7). Our data sets permit the use of earnings functions in place of mean earnings by educational level. The measures of cognitive skill and reasoning ability make it possible to estimate the effects on output of country differences not only in the quantity of education but also (by means of educational production functions) in its quality.

The Setting

The natural experiment in Kenya and Tanzania has been in progress for more than twenty years. The two countries are similar in size, resource endowment, structure of production and employment, and level of development, and we would not expect their urban wage economies to differ greatly in physical capital and technical conditions. But there are marked differences in one important dimension of the supply of educated labor: the number of workers with secondary education. Kenya and Tanzania achieved political independence in the early 1960s with equally undeveloped education systems and negligible stocks of indigenous educated manpower. Both are now close to achieving universal primary education, while university enrollments remain at less than 1 percent of the relevant age group. In this book we concentrate on the contribution of secondary education because it is at this level that the main policy issues arise in these countries.

Enrollments in secondary education have diverged in the two countries. In Kenya, which has a slightly smaller total population, secondary enrollment (forms 1–4) totaled 410,000 in 1980; in Tanzania it was 67,000. Secondary education is tightly rationed in Tanzania for financial, manpower planning, and ideological reasons, whereas in Kenya both the public and private sectors have been more responsive to demand. These differences in supply are reflected in the educational composition of the two wage labor forces. Country differences in the quality of secondary education may also have grown as the private and self-help system burgeoned in Kenya and as Tanzania adopted an egalitarian approach to secondary schools and stressed Kiswahili rather than English as the medium of instruction in primary school.

The Recursive Model of Cognitive Skill Acquisition and Earnings Determination, Revisited

In this exercise we utilize two of the three functions in the recursive model used in chapter 3:

$$H = a_0 + a_1R + a_2S + a_3B + a_4G + u \tag{5-1}$$

$$\ln W = b_0 + b_1R + b_2S + b_3H + b_4L + b_5L^2 + v \tag{5-2}$$

Equation 5-1 is our educational production function; estimates are presented in table 5-1.[6] Recall that in each country cognitive achievement bears a highly significant positive relationship to educational level and to ability. In Kenya secondary education raises H by 11.75 points, or by 35 percent at the means; similar results are obtained in Tanzania. The

Table 5-1. *Educational Production Functions*

Variable	*Kenya*	*Tanzania*	*Pooled sample*
S	11.754	10.939	11.611
	(8.50)	(8.84)	(12.07)
G	3.366	0.995	2.475
	(2.49)	(0.76)	(2.53)
B	−3.567	−2.651	−2.868
	(1.78)	(1.82)	(2.31)
R	0.570	0.487	0.519
	(5.55)	(5.58)	(7.47)
K	—	—	7.712
			(8.45)
Constant	15.49	12.34	9.903
$\bar{R}^2$	0.42	0.44	0.56
Standard error	8.77	7.76	8.45
Percentage standard error	21.1	26.2	23.5
N	205	179	379

— Not applicable.

Note: S, secondary education; G, an indicator of attendance at a government (as opposed to a private) school; B, birth in an urban area; R, reasoning ability; K, membership in Kenyan sample. The dependent variable is cognitive skill (H). Figures in parentheses are t-statistics.

elasticity of response of cognitive skill to reasoning ability at the means is roughly 0.4 in both countries.[7]

In our model for the determination of inputs into the educational production function, R is exogenous and S is influenced by R and by the availability of secondary school places, which is exogenous. Estimates of educational attainment functions were presented in chapter 3.[8] In both countries the probability of going to secondary school increases significantly with reasoning ability and with the size of the secondary in relation to the primary system at the time that primary schooling was completed. Ability thus influences the acquisition of cognitive skill both directly and, through access to secondary education, indirectly. The main difference in educational attainment between the two countries arises from the difference in the sizes of their secondary systems, which in turn can be attributed to differences in government policies. The implication is that in Kenya the market for secondary education is in equilibrium whereas in Tanzania there is excess demand for secondary school places. Estimates of private rates of return to secondary education and subjective responses to survey questions confirm our supposition of excess demand in Tanzania (see chapter 11).

Equation 5-2, our expanded human capital earnings function, allows us to distinguish the positive effects on earnings of cognitive skill acquisition (H) and of reasoning ability (R) from the effects of secondary school attendance (S). The last variable, S, is a ragbag that could represent credentialism (payment for secondary education irrespective of its productive effects), the use of schooling as a statistical screening device for unobserved characteristics, preschool human capital formation, or noncognitive human capital traits acquired in school. L is a proxy for postschool skill acquisition, the normal expectation being $b_4 > 0$ and $b_5 < 0$.

The estimates of equation 5-2 reported in table 5-2 are extracted from those presented in table 3-2. The coefficient on the experience term is positive and highly significant. The L^2 term was deleted from the estimated regression because its coefficient was not significant in either case. School attendance has a positive effect on earnings that is statistically significant in Kenya but not in Tanzania. Whereas the coefficient on reasoning ability is not significant in either country, that on cognitive skill is positive and significant at the 1 percent level in both. An extra point scored in the cognitive skill test raises earnings by 2 percent in Kenya and by 1.3 percent in Tanzania.

A Chow test indicates that the earnings functions are significantly different for the two countries. In particular, the return to cognitive skill is lower in Tanzania than in Kenya (table 5-2) despite Kenya's greater endowment of cognitive skill. This could suggest that the production function is more efficient, that other factors such as physical capital are relatively more abundant in Kenya, or that government pay policy depresses the return to cognitive skill in Tanzania. The available evidence

Table 5-2. *Earnings Functions*

Variable	*Kenya*	*Tanzania*
L	0.045	0.055
	(9.842)	(10.060)
S	0.192	0.112
	(2.469)	(1.417)
$\widehat{H}$	0.020	0.013
	(6.177)	(3.218)
R	0.006	0.0008
	(1.150)	(0.145)
Constant	5.476	5.726
$\bar{R}^2$	0.440	0.425
Standard error of ln W	0.405	0.419
N	205	179

Note: For definitions of variables, see note to table 5-1. The dependent variable is the logarithm of the wage (ln W). Figures in parentheses are t-statistics.

does not confirm these hypotheses, perhaps because of the limited number of observations in the subsample. The close similarity in skill-based occupational composition observed in the two full samples suggests that the demand for cognitive skill in relation to unskilled labor is also closely similar in the two countries.[9] Despite institutional evidence, corroborated by evidence from the full samples, of an egalitarian pay policy in the public sector of Tanzania (see chapter 7), the introduction in equation 5-2 of a dummy variable (P) for employment in the public sector and of a public sector–cognitive skill interaction term ($P \cdot H$) does not produce the hypothesized significant negative coefficient on the interaction term that we would expect to find given the lower returns to cognitive skill in the public sector.[10]

Education Policy and Differences in Cognitive Achievement

The average level of reasoning ability ($\bar{R}$) is much the same in the two countries—27.8 in Kenya and 26.4 in Tanzania. The means are not significantly different even at the 10 percent level. Levels of cognitive skill are, by contrast, substantially higher in Kenya than in Tanzania; mean scores for Kenya are 23 percent higher on the literacy test and 44 percent higher on the numeracy test. Mean cognitive skill scores ($\bar{H}$) are 40.0 in Kenya and 30.3 in Tanzania, an absolute difference of 9.7. The means are significantly different at the 1 percent level. The regression results from the pooled sample in table 5-1 indicate that even after differences in characteristics are standardized, the mean cognitive skill score of Kenyans exceeds that of Tanzanians by 7.7. A Chow test, however, rejected the null hypothesis that the educational production functions for the two countries are the same. This is therefore not the best estimate of the part of the difference in cognitive skill that can be attributed to differences in educational production functions. We measure this difference by means of decomposition analysis.

Since the mean cognitive skill of Kenyans is determined by the educational production function $\bar{H}_k = f_k(\bar{X}_k)$, where $\bar{X}_k$ are the mean values of the independent variables, the mean value that Tanzanians would achieve if the Kenyan production function were to apply would be $f_k(\bar{X}_t)$. The gross difference between the two countries is then decomposed as follows:

$$\bar{H}_k - \bar{H}_t = f_k(\bar{X}_k - \bar{X}_t) + [f_k(\bar{X}_t) - f_t(\bar{X}_t)] \tag{5-3}$$

or

$$\bar{H}_k - \bar{H}_t = f_t(\bar{X}_k - \bar{X}_t) + [f_k(\bar{X}_k) - f_t(\bar{X}_k)] \tag{5-3'}$$

The first term on the right-hand side of each equation shows the component that is explained by differences in the proportion of workers with secondary education and in the mean values of the other explanatory variables, and the second term can be interpreted as a measure of the difference in the quality of education, in the sense that output per unit of inputs is higher in one country than in the other.

As expected, country differences in the explanatory variables other than educational attainment contribute little to the explanation. Differences in the quantity of secondary education account for 15 percent of the gross difference if the Kenyan educational production function is used and for 14 percent if the Tanzanian function is used. This reflects the differing proportion of secondary completers in the full sample total of primary and secondary completers; $\bar{S}$ is 0.532 in Kenya and 0.414 in Tanzania. The residual, however, accounts for no less than 75 percent when the Tanzanian educational production function is used or 78 percent when the Kenyan function is used. For given mean values of the explanatory variables, the predicted cognitive skill score with the Kenyan educational production function as predictor greatly exceeds that with the Tanzanian function as predictor.

This result suggests that country differences in the quality of education are important determinants of cognitive achievement. We equate the residual with differences in quality, although we recognize that differences in the incentive systems in the two countries could produce differences in drive and family support that might contribute to the residual. The lower quality of education in Tanzania could stem from divergent education policies. Teaching inputs are of the same magnitude in the two countries, and cost per student is actually higher in Tanzania because a higher proportion of students is in boarding schools. Tanzania, however, has placed greater stress on curriculum diversification, at the cost perhaps of time spent on general academic skills, and on Kiswahili in primary school, perhaps to the detriment of efficient learning in English in secondary school.

The Simulation Methodology

The two functions can be used together in simulations to answer the following counterfactual questions. What is the effect on the average cognitive skill of the Tanzanian labor force of increasing the quantity of education to the Kenyan level? What is the effect on the average cognitive skill of the Tanzanian labor force of increasing the quality of education to the Kenyan level?

To answer the first question, we substitute the Kenyan for the Tanzanian mean value of the secondary school dummy variable[11] and predict the cognitive skill score with the use of the Tanzanian educational production function:

$$\hat{\bar{H}}_t = a_{0_t} + a_{1_t}\bar{R}_t + a_{2_t}\bar{S}_k + a_{3_t}\bar{T}_t + a_{4_t}\bar{B}_t + a_{5_t}\bar{G}_t \tag{5-4}$$

To answer the second question, we substitute the Kenyan for the Tanzanian educational production function and predict the cognitive skill score with the use of the Tanzanian mean values of the independent variables:

$$\hat{\bar{H}}_t = a_{0_k} + a_{1_k}\bar{R}_t + a_{2_k}\bar{S}_t + a_{4_k}\bar{B}_t + a_{5_k}\bar{G}_t \tag{5-5}$$

We can then ask, what is the effect on average earnings in Tanzania if first the quantity, then the quality, and then both the quantity and the quality of education in Tanzania are increased to the Kenyan level? To answer the question, we substitute the mean cognitive skill score associated with each of these counterfactual changes in education policy for actual cognitive skill in the Tanzanian earnings function to predict the consequent change in mean wages:

$$\widehat{\ln \bar{W}_t} = b_{0_t} + b_{1_t}\bar{S}_{t,k} + b_{2_t}\bar{R}_t + b_{3_t}\hat{\bar{H}}_t + b_{4_t}\bar{L}_t \tag{5-6}$$

The subscript on $\bar{S}$ is either k or t, as is explained below.

The assumptions implicit in these exercises are that the policy changes do not affect the coefficients of the functions or the mean values of the other independent variables and that, as a consequence of the rationing of secondary places in Tanzania, there is an effective demand for the simulated increases in supply.

Cross-Country Policy Simulations

Our results suggest that more literate and numerate workers are more productive. Tanzania has thus paid a price in output forgone by restraining the growth of secondary education and reducing the quality of education for the sake of other goals. Our next exercise is to quantify this price by simulating the effect on wages, and thus on productivity, of differences between the two countries in the quantity and quality of education.

The results of our simulation exercises are presented in table 5-3. The base runs use the actual values of both variables and coefficients; the predicted and weighted actual mean levels of cognitive skill and geometric mean levels of earnings are therefore the same. Simulation 1 shows the effect of the change in quantity, simulation 2 the effect of the change in quality, and simulation 3 the effect of simultaneous changes in quantity and quality. The Tanzanian simulations introduce parameters from Kenya, and the Kenyan simulations introduce parameters from Tanzania.

An increase in the quantity of secondary education in Tanzania to the Kenyan level would, on the basis of equations 5-1 and 5-2, increase the mean cognitive skill of the labor force by 4 percent and mean earnings

Table 5-3. *Policy Simulations: The Effect on Cognitive Achievement and Earnings of Varying the Quantity and Quality of Education*

Item	*Base run*	*Simulation*				
		1	*1a*	*2*	*3*	*3a*
			Kenya			
Educational production function						
Mean values						
$\bar{S}$	0.532	0.414	0.414	*	0.414	0.414
$\bar{R}$	27.816	*	*	*	*	*
$\bar{F}$	0.110	*	*	*	*	*
$\bar{G}$	0.700	*	*	*	*	*
Coefficients						
S	11.754	*	*	10.938	10.939	10.938
R	0.570	*	*	0.487	0.487	0.487
F	−3.567	*	*	−2.651	−2.651	−2.651
G	3.366	*	*	0.995	0.995	0.995
Constant	15.490	*	*	12.340	12.340	12.340
Predicted cognitive skill						
Mean ($\hat{\bar{H}}$)	39.562	38.175	38.175	32.111	30.820	32.820
Change in mean ($\triangle\hat{\bar{H}}$)	—	−1.39	−1.39	−7.45	−8.74	−8.74
Percentage change in mean	—	−3.5	−3.5	−18.8	−22.1	−22.1
Earnings function						
Mean values						
$\bar{S}$	0.532	0.414	*	*	0.414	*
$\bar{R}$	27.816	*	*	*	*	*
$\bar{L}$	9.026	*	*	*	*	*
$\bar{H}$	39.562	38.175	38.175	32.111	30.820	30.820
Coefficients						
S	0.1924	*	*	*	*	*
R	0.0058	*	*	*	*	*
L	0.0448	*	*	*	*	*
H	0.0197	*	*	*	*	*
Constant	5.4757	*	*	*	*	*
Predicted earnings						
Mean ($\hat{\bar{W}}$)	1,014	966	987	877	835	854
Change in mean ($\triangle\hat{\bar{W}}$)	—	−48	−27	−138	−179	−160
Percentage change in mean	—	−4.8	−2.7	−13.6	−17.6	−15.8
			Tanzania			
Educational production function						
Mean values						
$\bar{S}$	0.414	0.532	0.532	*	0.532	0.532
$\bar{R}$	26.434	*	*	*	*	*

Item	*Base run*	*Simulation*				
		1	*1a*	*2*	*3*	*3a*
$\bar{F}$	0.190	*	*	*	*	*
$\bar{G}$	0.730	*	*	*	*	*
Coefficients						
S	10.939	*	*	11.754	11.754	11.754
R	0.487	*	*	0.570	0.570	0.570
F	−2.651	*	*	−3.567	−3.567	−3.567
G	0.995	*	*	3.366	3.366	3.366
Constant	12.340	*	*	15.490	15.490	15.490
Predicted cognitive skill						
Mean ($\bar{\hat{H}}$)	29.964	31.255	31.255	37.202	38.589	38.259
Change in mean ($\triangle\bar{\hat{H}}$)	—	1.29	1.29	7.24	8.63	8.63
Percentage change in mean	—	4.3	4.3	24.2	28.8	28.8
Earnings function						
Mean values						
$\bar{S}$	0.414	0.532	*	*	0.532	0.414
$\bar{R}$	26.434	*	*	*	*	*
$\bar{L}$	7.163	*	*	*	*	*
$\bar{H}$	29.964	31.255	31.255	37.202	38.589	38.589
Coefficients						
S	0.1125	*	*	*	*	*
R	0.0008	*	*	*	*	*
L	0.0550	*	*	*	*	*
H	0.0129	*	*	*	*	*
Constant	5.7261	*	*	*	*	*
Predicted earnings						
Mean ($\bar{\hat{W}}$)	717	738	728	787	812	801
Change in mean ($\triangle\bar{\hat{W}}$)	—	21	11	70	95	84
Percentage change in mean	—	2.9	1.6	9.7	13.2	11.7

— Not applicable. * Same as for base run.

Note: For definitions of variables, see note to table 5-1. Simulation 1 shows the effect of a change in the quantity of secondary education, simulation 2 the effect of a change in the quality of education, and simulation 3 the effect of a simultaneous change in quantity and quality. Simulations 1a and 3a differ from simulations 1 and 3 only in that the value of S in the other country is not substituted in the earnings function.

Whereas the coefficients are derived from the unweighted subsamples, the mean values are derived from the subsamples weighted according to the proportions of primary and secondary completers in the full samples.

The mean for cognitive skill is an arithmetic mean and that for earnings is a geometric mean because the dependent variable in the earnings function is logarithmic.

by 3 percent; an increase in the quality of education would increase cognitive skill by 24 percent and earnings by 10 percent; and a simultaneous increase in quantity and quality would increase cognitive skill by 29 percent and earnings by 13 percent.

Do these increases in predicted earnings—the result of assumed increases in $\bar{H}$ and in $\bar{S}$—also measure the increase in the productivity of the labor force? The effect on earnings of the rise in $\bar{H}$ can only be interpreted as representing a productivity relationship. Although the coefficient on S could reflect unmeasured human capital acquired in secondary school, it might instead reflect credentialism, screening for ability, or preschool human capital; in that case the rise in $\bar{S}$ would make no contribution to productivity. Simulations 1a and 3a differ from simulations 1 and 3 only in that the value of $\bar{S}$ in the other country is not substituted in the earnings function. They therefore show the lower-bound estimate of the effect on productivity of expanding secondary education in Tanzania to the Kenyan level. The combined effect on productivity of quantity and quality changes is 12 percent.

These simulations suggest that the opportunity costs to Tanzania of constraining the quantity and quality of education are substantial The mean wage of the weighted subsample for Kenya was 41 percent higher than that for Tanzania when converted at the official exchange rate; it would be even higher if calculated on the basis of purchasing power parity. In 1971, before the effects of the divergent education policies were manifested in the labor market, the mean urban wage in Kenya was only about 10 percent higher. A third of the current difference in predicted mean wages converted at the official exchange rate (94 Kenyan to 297 Tanzanian shillings) can be explained by the lower cognitive skill of the Tanzanian labor force.

It is reassuring that similar results are generally obtained when the simulations are conducted on the Kenyan subsample (table 5-3). The main contrast is that an even higher proportion of the difference in predicted mean wages (60 percent) can be explained by the higher cognitive skill of Kenyan workers. Even if the use of a purchasing power parity conversion factor were to reduce these percentages, the difference in cognitive skill would remain important. The use of the log linear instead of the linear specification of the educational production function would not alter our conclusions.

As a guide to the potential gains from improving the quantity and quality of education in Tanzania, these estimates may be biased in four respects. First, they take no account of the diminishing returns to large increases in the supply of cognitive skill in relation to other inputs. In chapter 8 we use the Kenyan and Tanzanian surveys to estimate the elasticity of relative earnings with respect to relative educational expansion—the inverse of the elasticity of substitution between educational levels.

Our estimate is that if the ratio of secondary to primary completers in the Tanzanian wage labor force were increased to the Kenyan level, the ratio of the earnings of the two groups would decrease by about 12 percent; the predicted gain in labor productivity would be little affected by the diminishing returns. This result squares with our finding that the returns to cognitive achievement are not significantly lower in the manual occupations, which would absorb much of the additional supply of high cognitive achievers, than in the white-collar occupations, where they are now concentrated in Tanzania (see chapter 3).

Second, the fact that access to secondary schooling is meritocratic implies that the expansion of secondary enrollment in Tanzania would reduce the qualifications of entrants to the secondary system and that our simulations overestimate the increase in productivity from educational expansion.

Third, the upward bias in the estimate that arises from the above considerations may be offset by the downward bias caused by any failure to capture in our specifications the depressing effect of pay policy on the returns to cognitive skill in Tanzania. Although the relative supply of cognitive skill is greater in Kenya, the return to achievement is higher. As a consequence, when the Kenyan instead of the Tanzanian earnings function is used to measure the effect of changing the quantity and quality of education, the change in earnings produced is more than 4 percent greater (table 5-3).

Fourth, although it is plausible that higher cognitive skill commands higher earnings because it raises the productivity of labor, only under the rigorous assumptions required for marginal product to equal wage will the increase in productivity equal the increase in earnings. There may be a direct proportional relationship, however, such that the change in productivity will exceed the change in the wage (if, for instance, monopoly in the product market depresses the wage below marginal product) or will fall short of the change in the wage (if, for instance, public sector employment exceeds the most profitable level). We cannot therefore claim that the predicted absolute increase in average earnings in Tanzania precisely measures the absolute increase in average labor productivity, but the percentage increases are likely to be similar.

Conclusions

The research design has been comparative—first, to establish which relationships are robust; second, to explain the differences in relationships between the two countries; and third, to illuminate a particular issue on which policies in otherwise similar countries have differed greatly. Two findings that are important not only because they pass the usual statistical tests but also because they hold in both countries are the positive effect of secondary education on cognitive skill and the positive effect of cognitive skill on earnings. The findings confirm that the relationship between secondary education and earnings shows the effect that human capital acquisition in school has on productivity at work.

The observed differences in relationships and in parameters also assist the analysis. The difference in educational production functions permits identification of the effects of educational quality, and the difference in mean secondary attendance permits identification of the effects of educational quantity. The recursive model, which is estimated in the same way in the two countries, makes possible a cross-country productivity accounting analysis of the effects of education.

Kenya and Tanzania differ considerably in the quality of secondary and presecondary education and in the quantity of secondary education. The cognitive skill of workers with the same ability and school attendance is substantially higher in Kenya than in Tanzania, as are secondary enrollment rates and the level of education of the labor force. Consequently, the average level of cognitive skill—and therefore the earnings and productivity of labor—is far higher in Kenya. If the quantity and quality of education in Tanzania were raised to the Kenyan level, earnings would be 13 percent higher. Since labor productivity is likely to rise by a similar percentage, the economic benefits to Tanzania from pursuing such a policy would be substantial. The differences between the two countries in education policy regimes appear to have been an important factor in their diverging mean earnings and labor productivity.

The difference in labor productivity attributable to the difference in policies for secondary education is likely to grow with time. The educational composition of the labor force in 1980 did not fully reflect the divergence in policies that took place in the 1970s. The value of $\bar{S}$ (form 4 leavers as a proportion of the total of standard 7 and form 4 leavers) for the sample as a whole was still only moderately higher in Kenya (0.53) than in Tanzania (0.41). For this reason the effect of simulating a rise to the Kenyan level in the quantity of secondary education in Tanzania was modest; labor productivity rose by 3 percent. But the difference in $\bar{S}$ for the cohort that had entered the labor force within the previous six years was more marked; $\bar{S}$ was 0.65 in Kenya and 0.38 in Tanzania. If present policies continue, the ensuing change in the educational composition of urban wage employment will increase the difference in $\bar{S}$ and so increase the difference in labor productivity attributable to secondary education.

We have given some reasons why the estimates from the simulation analysis may be biased and why our results must therefore be regarded as suggestive rather than conclusive. Nevertheless, these results have been obtained while avoiding some of the common drawbacks in output or growth accounting analyses of the contribution of education. The greater similarity of the two urban wage economies and the greater comparability of our data have permitted more realistic simulation exercises than are normally feasible in cross-country output accounting studies. And through the introduction and measurement of cognitive skill as a link between education and earnings it has been possible to answer questions of causality that others have simply had to beg.

Notes

1. Another version of the same exercise was conducted by Fallon and Layard (1975) with similar data sources for a different set of twenty-three countries. They applied the estimated parameters of a three-factor, two-level constant elasticity of substitution (CES) production function, which distinguished crudely between educated and uneducated labor, to measure the effect on per capita output in the United States of introducing in turn the endowments of different factors and the efficiency parameter from each of the other countries. The contribution of each factor, including human capital, was then compared with that of other factors and with the actual difference in per capita output.

2. Fallon and Layard found that the contribution of their index of human capital was a good deal lower than Krueger's estimate and generally smaller than that of physical capital.

3. See, for instance, Denison (1967), pp. 82–87. Krueger (1968) made no attempt to separate the contribution of education from that of its likely correlates.

4. Attempts in growth accounting to allow for nonmarginal educational expansion have used assumed or estimated elasticities of substitution between education and other factors to measure the effect on factor prices and factor weights (see, for instance, Dougherty 1971 and Selowsky 1971); attempts to allow for the changing structure of factor prices have involved the use of a chain-linked Divisia index (see, for instance, Jorgenson and Griliches 1967).

5. Fallon and Layard (1975, pp. 296–97) showed that their measure would overstate the contribution of education when the comparator country had a less efficient production function and was less well endowed in all factors than the United States, in the sense that the sum of all contributions would exceed the actual productivity differences to be explained.

6. A log-linear specification in which ln H, ln R, and ln T replaced H, R, and T was also estimated but was inferior in that the percentage standard error of H was greater (29 percent in Kenya and 31 percent in Tanzania) and the significance of some coefficients was lower. See table 3-6.

7. See chapter 3 for a discussion of the other variables included in the equation. The equations were initially estimated with a variable that measured the length of time since the respondent had left school. As this is a proxy for change in the quality of schooling over time and for gain or loss of cognitive skill after leaving school, the sign of its coefficient cannot be predicted. In neither country was the coefficient significantly different from zero, and the term was therefore deleted.

8. Recall that tests of recursiveness relating equation 5-1 to equations 3-1 and

3-2 failed to reject the null hypothesis that the equation system is recursive.

9. The criterion for occupational classification was the level of the skills likely to be involved in a job. See appendix G for a more detailed discussion.

10. Their introduction for Tanzania has negligible effects on the explanatory power of equation 5-2 and on the coefficients of the other variables and yields the coefficients $0.036P$ and $0.002P \cdot H$. (The respective *t*-statistics are 0.158 and 0.031). When interaction terms are added for all the independent variables ($P \cdot R$, $P \cdot S$, $P \cdot H$, and $P \cdot L$), the coefficient on $P \cdot H$ remains insignificant at 0.006 (*t*-statistic 0.528).

11. The mean value is taken from the full sample, since quota sampling by educational level was used in selecting the subsample.

Part III

EDUCATIONAL EXPANSION, GOVERNMENT POLICY, AND THE STRUCTURE AND DISPERSION OF PAY

CHAPTER 6

Education, Occupation, and the Operation of the Labor Market

OUR MAIN OBJECTIVE IN PART III is to measure the relationship between the educational structure of wages and the relative supply of educated labor. In this chapter we throw light on the way in which the labor market operates and in particular on the role of occupation. We argue that the occupation of a worker is an important intermediary between his education and his earnings. Education, which primarily represents cognitive skill, is shown to be a powerful influence on occupational attainment. Because elements of human capital are occupation specific, the occupation of a worker is an important determinant of the vocational skills that he acquires and therefore of his earnings.

Our analysis in chapter 4 of the complementary relationships between cognitive and vocational skills was confined to the tested subsamples, which were too small to allow the integration of occupation into the analysis. Use of the full samples adds an additional dimension to our understanding of the relationship between education and productivity and provides a framework for analyzing the consequences of educational expansion for the occupational attainment of the educated and hence for their earnings. Accordingly, this chapter serves as a bridge between parts II and III.

Why Occupation Could Matter

The usual practice among economists is to explain earnings in terms of the individual characteristics of workers, not the characteristics of the work that they perform. Occupation is treated simply as a correlate of individual characteristics and not as an independent influence on earnings. We shall argue that job-related as well as individual characteristics can be important and that the two are likely to interact.

Note: Adapted from J. de Beyer and J. B. Knight, "The Role of Occupation in the Determination of Wages," *Oxford Economic Papers* 41, no. 3 (July 1989).

There are ways in which occupation itself may influence wages. First, some occupational wage differences compensate for the nonpecuniary advantages and disadvantages of different jobs. Second, institutional barriers to movement between occupations and institutional influences on wage determination may prevent or retard the equalization of wages in response to market forces. Third, since additional pay is needed to compensate for training costs incurred by workers, occupational wages differ according to the amount of vocational skill involved in the job. The size of the wage differences attributable to differences in occupational skill depends on the degree of capital market imperfection—that is, on the extent to which acquisition of skills is rationed. Fourth, the value of personal characteristics such as natural ability and cognitive skill acquired in formal education can vary among occupations, and these characteristics can also assist in the acquisition of vocational skills. Thus the wage in one occupation may exceed that in another because one job inherently requires superior personal characteristics—some natural and some acquired, some observable to the researcher and some hidden.

The last three arguments require further analysis, which is provided in appendix F. A summary is sufficient here. We introduce the notion of an occupational production function that shows an occupation-specific relationship between inputs—such as cognitive skill, vocational skills, and natural ability—and the output of a worker. A simple form of the occupational production function shows, for each occupation, a relationship between years of education and productivity. Productivity is likely to depend positively on years of education over a certain range, but different functions may have different positions and slopes.

The benefits of additional education differ among occupations for two reasons. First, the cognitive skill acquired in education may simply be of more value in some occupations than in others. For instance, a worker's cognitive skill level is more likely to affect his performance if he is a clerk or a motor mechanic than if he is a sweeper or a factory hand. Second, education may itself be an argument in the production function of postschool human capital, and some occupations may involve greater skill formation on the job than others.

Imperfections in the capital market work to ration education at the upper levels and raise occupational production functions for occupations filled by the educated. As is shown in appendix F, in competitive markets there is no inconsistency between the concept of the occupational production function and the Mincerian relationship between education and productivity, which ignores occupation. It is when capital or labor markets are not competitive that the occupational production function is most useful as an analytical device.

It is plausible that there will be an occupation-specific nexus of relationships among the measured variables education, formal training, employment experience (a proxy for informal training), and earnings. Some occupations involve more vocational skill than others and therefore offer workers higher wages once their skill acquisition is complete. Additional education is more valuable in some occupations than in others both because it raises productivity directly and because it facilitates formal and informal training. We predict, therefore, that current earnings vary by occupation when other measured inputs are standardized and that the response of wages to additional education, to training, and to additional years of experience varies among occupations.

Instead of estimating an earnings function in terms of a vector of personal characteristics $W = F(\mathbf{X})$, we propose to divide the procedure into two parts: an earnings function that also contains occupation terms (O_i) as explanatory variables

$$W = W(\mathbf{X}, O_i) \tag{6-1}$$

and an occupational attainment function in which the worker's occupation is explained in terms of a vector of personal characteristics $(\mathbf{Z})$:

$$O_i = O_i(\mathbf{Z}). \tag{6-2}$$

The advantage of this procedure over the reduced form $W = W(\mathbf{X}, \mathbf{Z})$ is that it may reveal more about the way in which the labor market operates, particularly the way in which the market responds to an increase in the supply of educated labor.

Occupational Earnings Functions

Particular care was taken in classifying the occupation of a respondent according to skill content (see appendix E). For the purposes of this chapter respondents were placed in six broad occupational groups: unskilled manual (O_5), semiskilled manual (O_4), skilled manual (O_3), junior clerical (O_{2b}), senior clerical (O_{2a}), and supervisory (O_1). We hypothesize that skill level ascends among the manual groups in the order O_5, O_4, and O_3 and among the nonmanual groups in the order O_{2b}, O_{2a}, and O_1. We expect the nonmanual to be more skilled than the manual occupations, although we are least confident about the ranking of the contiguous groups O_3 and O_{2b}. One reason why occupation is not normally incorporated into the analysis of wages is that the occupational information available from most labor force surveys is very crude, being a murky blend of activity, status, and skill. By contrast, our classification corresponds to the concepts appropriate for the economic analysis of occupation.

Another virtue of the classification system chosen for our samples is that, as will be shown below, there is little mobility of workers among the six occupational groups. Allocation to a particular occupational

Table 6-1. *Mean Wage, Standard Deviation of Wages, and Distribution of Employees, by Occupation*

Occupational classification	*Mean wage (shillings per month)*	*Standard deviation of wages (shillings per month)*	*Index of mean wage (skilled manual = 100)*	*Standardized index of mean wage (skilled manual = 100)*	*Distribution of employees (total = 100)*
Kenya					
O_1	3,447	2,270	354	221	10.4
O_{2a}	2,238	1,017	230	201	7.1
O_{2b}	1,408	875	145	137	24.8
O_3	973	562	100	100	23.2
O_4	699	360	72	79	16.4
O_5	574	208	59	76	18.1
Total	1,330	1,475	137	114	100.0
Tanzania					
O_1	2,075	1,019	229	160	12.3
O_{2a}	1,633	679	180	163	4.8
O_{2b}	930	529	103	91	28.6
O_3	905	518	100	100	21.3
O_4	641	298	71	71	16.3
O_5	541	211	60	72	16.7
Total	990	726	109	94	100.0

Note: O_1, supervisory; O_{2a}, senior clerical; O_{2b}, junior clerical; O_3, skilled manual; O_4, semiskilled manual; O_5, unskilled manual. There are 1,767 observations in Kenya and 1,726 in Tanzania. The standardized index of mean wage is derived from the wage function in table 6-2, with education as a continuous variable (column 2); the index refers to a worker with the mean characteristics of the sample.

group is therefore likely to be an important determinant of lifetime vocational skill acquisition and lifetime earnings.

As table 6-1 shows, the occupational wage structures and occupational distributions for the two countries are similar. The occupational hierarchy by mean wage corresponds precisely to our judgment about the occupational hierarchy by skill level. Nearly half (45 percent in Kenya and 42 percent in Tanzania) of the variance in wages occurs between the six occupations; the remaining variance—that within occupations—is attributable to the other determinants of wages.

Wage functions of the following form are presented in table 6-2:

$$(6\text{-}3) \quad W = a + bE + cL + dL^2 + eV_1 + fS_1 + gT_1 + \Sigma\, h_i O_i + u$$

where W is the natural logarithm of the wage, E is years of education, L is years of employment experience, V_1 is possession of formal training, S_1 denotes male sex, T_1 denotes non-African race, and O_i are the occupation terms.[1] The variables E, L, L^2, and V_1 represent aspects of human capital acquisition, and S_1 and T_1 are personal characteristics that are hypothesized to be favored in the labor market. Human capital theory predicts that $b > 0$, $c > 0$, $d < 0$, and $e > 0$, and labor market discrimination implies that $f > 0$ and $g > 0$ and that occupation-specific skill operates so that $h_1 > h_{2a} > h_{2b} > 0 > h_4 > h_5$ (with O_3 the omitted category).

In both countries the human capital variables E, L, and L^2 have the expected signs and are significant at the 1 percent level. When education in the linear form (E) is replaced by a set of education dummies (E_k), the coefficients retain their expected signs and significance. The coefficient on formal training is always positive (although it is not significantly so in Tanzania when the occupation terms are included). There is evidence of discrimination in favor of non-Africans in both countries and against women in Tanzania, but these variables may simply be serving as proxies for unmeasured productive characteristics.

When the occupation terms are included in the equation, significantly more of the variance in earnings is explained.[2] The coefficients of these terms are all significant—that is, significantly different from the coefficient of the omitted skilled manual category. The ordering of the coefficients in Kenya corresponds precisely to our ranking of occupations by skill level. The ordering in Tanzania almost corresponds to it: junior clerks are paid slightly less than skilled manual workers, other things being equal, and semiskilled workers are paid slightly less than unskilled workers, but the latter difference is not significant. The occupation and other coefficients of table 6-2 can be used to obtain the index of standardized mean wages shown in table 6-1. The other characteristics that determine wages are standardized by assuming that workers possess the sample mean values of the explanatory variables (other than occupation). This narrows the occupational wage structure, as is to be expected;

Table 6-2. *Wage Functions with and without Occupation Terms*

Item	*1*	*2*	*3*	*4*
Kenya				
E	0.117**	0.054**	—	—
E_1	—	—	−0.375**	−0.166*
E_2	—	—	−0.202**	−0.032
E_4	—	—	0.480**	0.224**
E_5	—	—	1.243**	0.625**
L	0.058**	0.042**	0.072**	0.048**
L^2	−0.0008**	−0.0006**	−0.0013**	−0.0008**
V_1	0.223**	0.135**	0.250**	0.140**
S_1	−0.057	0.045	−0.033	0.065
T_1	0.740**	0.487**	0.599**	0.417**
O_1	—	0.863**	—	0.793**
O_{2a}	—	0.700**	—	0.701**
O_{2b}	—	0.311**	—	0.313**
O_4	—	−0.206**	—	−0.236**
O_5	—	−0.240**	—	−0.277**
Constant	5.348	5.809	5.958	6.103
$\bar{R}^2$	0.410	0.517	0.418	0.522
F	191	160	133	129
N	1,643	1,637	1,653	1,646
Mean of ln wage ($\bar{W}$)	6.871	6.870	6.880	6.878
Mean of wage ($\bar{Y}$)	1,318	1,297	1,343	1,321
Tanzania				
E	0.077**	0.037**	—	—
E_1	—	—	−0.277**	−0.143**
E_2	—	—	−0.220**	−0.100*
E_4	—	—	0.364**	0.163**
E_5	—	—	0.764**	0.387**
L	0.057**	0.047**	0.062**	0.050**
L^2	−0.0008**	−0.0007**	−0.0009**	−0.0008**
V_1	0.073*	0.040	0.095**	0.053
S_1	0.307**	0.331**	0.299**	0.324**
T_1	0.524**	0.357**	0.503**	0.353**
O_1	—	0.503**	—	0.469**
O_{2a}	—	0.485**	—	0.487**
O_{2b}	—	−0.094*	—	−0.097*
O_4	—	−0.345**	—	−0.350**
O_5	—	−0.322**	—	−0.334**
Constant	5.319	5.765	5.773	5.987
$\bar{R}^2$	0.378	0.489	0.384	0.491
F	164	138	112	109
N	1,607	1,578	1,607	1,578
Mean of ln wage ($\bar{W}$)	6.684	6.681	6.684	6.681
Mean of wage ($\bar{Y}$)	985	983	985	983

(*Notes continue on the following page.*)

workers in the better-paying occupations tend to be better endowed with productive characteristics.

The inclusion of the occupation terms in the wage function reduces the coefficient on years of education by more than half and decreases the coefficients on formal training and non-African race. This is because of the positive correlation between these variables and occupation ordered by skill content. The better-paying occupations tend to attract higher proportions of workers who have had more than *x* years of schooling, who have had formal training, and who are of non-African race. The inclusion of occupation therefore raises the econometric problem of multicollinearity, but it does not necessarily bias the coefficients of the equation. Upward bias in the occupation coefficients would arise from a positive correlation between occupation and the error term in the equation—for example, between occupation and unmeasured ability. Such a correlation is indeed predicted by our model because ability is likely to assist skill formation.

The role of occupation might therefore be exaggerated by the estimated coefficients, but it is implausible that occupation is simply acting as a proxy for ability. Although a correlation between education and ability is widely acknowledged—and is also predicted by our model—few would argue that education therefore has no causal effect on wages or that it has no place in the wage function. The possibility of bias is not a reason for excluding the occupation terms, particularly if there is further evidence that occupation plays a role in wage determination.

The sole addition of straightforward occupation dummies to the wage function is consistent with only a very simple version of the occupational production function, that is, one in which the coefficients on employment experience, on formal training, and on education in the wage function do not vary among occupations. It is implicit in the general model that there are occupational differences not only in the level of wages but also in the returns to education, to formal training, and to employment experience.

Our first test for such interaction effects was to add to the equation with a linear education term and with occupation terms (table 6-2, column 2) a set of interaction terms, $E \cdot O_i$, $L \cdot O_i$, and $L^2 \cdot O_i$ (equation not shown). The contribution of these interaction terms as a set proved

Notes to table 6-2.

—Not applicable.

* Statistically significant at the 5 percent level.

**Statistically significant at the 1 percent level.

Note: E, years of education; E_1, no education; E_2, primary standards 1–4; E_4, secondary forms 1–4; E_5, post–form 4; L, employment experience; V_1, formal training; S_1, male sex; T_1, non-African race. Occupation variables are as defined in table 6-1. Column numbers identify different regression specifications.

to be statistically significant at the 1 percent level in both countries.[3] All the coefficients on the $E \cdot O_i$ terms were significantly different from zero in Kenya, as were three of the five in Tanzania. Since O_5 was the base category, this showed significant differences between the returns to education in the unskilled manual and in the other occupations. The withdrawal of the $E \cdot O_i$ terms as a set proved significant at the 1 percent level in both countries, as did the withdrawal of the $L \cdot O_i$ and $L^2 \cdot O_i$ terms as a set.[4] The omission from the full equation of the $L \cdot O_i$ and $L^2 \cdot O_i$ terms, one occupation at a time, had a significant effect in two of the five cases for Kenya and in three of the five cases for Tanzania. In those occupations, therefore, the returns to experience were significantly greater than in the unskilled manual category. These tests generally provided statistical support for the inclusion of interaction terms and for our hypothesis of occupational differences in the returns to education and to experience.

Table 6-3 reports wage functions for each occupation. The percentage of the variance in W explained by the equation is low in the unskilled manual occupation but tends to rise with occupational skill level. The coefficients on the education dummy variables are generally significant and of the expected sign in the more skilled occupations. The coefficients on employment experience are all positive, and almost all are significantly so; those on the squared term are generally negative, and most are significant. Again, the coefficients on formal training are rarely significant; indeed, some are negative.[5] It is notable from the mean values of selected independent variables, also shown in table 6-3, that occupational skill level, according to our ranking, is strongly correlated with educational attainment, formal training, and race.

Do the returns to education differ among occupations, as we have predicted? Figure 6-1 shows how, within each occupation, the wage varies with educational level, other things being equal. We standardize for the differences in characteristics of workers both within and between occupations by showing the wage of a representative worker in the labor market; that is, by assuming that the worker possesses the mean values of the explanatory variables (other than education) for the sample as a whole. The occupational differences in wages at each educational level therefore correspond solely to differences in the coefficients and constant terms of the occupation-specific wage functions.

In both countries the vertical ordering of occupations again corresponds to that of our hypothesized skill levels. The wage is weakly responsive to education in unskilled and semiskilled manual jobs but rather more responsive in skilled manual jobs. Wages in nonmanual occupations, by contrast, are extremely sensitive to educational level; it is in these jobs that education pays off. The results for the two countries are similar, the main difference being that there are higher returns to educa-

Table 6-3. *Occupation-Specific Wage Functions: Coefficients and Selected Mean Values*

Item	*Unskilled manual* (O_5)	*Semiskilled manual* (O_4)	*Skilled manual* (O_3)	*Junior clerical* (O_{2b})	*Senior clerical* (O_{2a})	*Supervisory* (O_1)
Kenya						
E_1	0.099	−0.484**	−0.415*	—	—	—
E_2	0.006	−0.017	−0.086	−0.474	1.472*	−1.166
E_4	0.115	0.108	0.162*	0.292**	0.301*	0.829**
E_5	—	−0.080	0.918**	0.775**	0.512*	1.064**
L	0.029**	0.059**	0.046**	0.039**	0.051	0.029
L^2	−0.0006**	−0.0010**	−0.0008**	−0.0001	−0.0008	−0.0001
V_1	0.249	0.324	0.027	0.159**	−0.003	0.273**
S_1	−0.019	0.530**	0.408	−0.074	−0.259*	0.335*
T_1	—	−0.293	0.659	0.543**	0.146	0.541**
Constant	6.022	5.436	5.868	6.442	7.005	6.225
$\bar{R}^2$	0.049	0.246	0.117	0.257	0.111	0.287
F	2.98	10.92	6.69	19.23	2.93	9.57
N	268	274	386	422	124	171
Selected mean values						
$\bar{E}$	5.71	6.17	7.42	10.29	10.62	12.70
$\bar{E}_1$	0.19	0.09	0.03	0.00	0.00	0.00
$\bar{E}_2$	0.14	0.23	0.10	0.01	0.01	0.00
$\bar{E}_4$	0.24	0.25	0.29	0.66	0.69	0.30
$\bar{E}_5$	0.00	0.00	0.02	0.12	0.13	0.61
$\bar{V}_1$	0.00	0.04	0.30	0.32	0.34	0.43
$\bar{T}_1$	0.00	0.02	0.00	0.03	0.08	0.22
ln wage ($\bar{W}$)	6.241	6.388	6.727	7.084	7.653	7.930
Tanzania						
E_1	−0.060	−0.080	−0.241	−0.001	0.985*	—
E_2	0.113	0.014	−0.058	−0.138	—	—
E_4	0.016	0.178	0.239**	0.173**	0.229	0.188
E_5	—	0.436	0.311	0.488**	0.462*	0.449**
L	0.038*	0.041**	0.023*	0.088**	0.047*	0.074**
L^2	−0.0008**	−0.0006*	0.0000	−0.0019**	−0.0012	0.0011*
V_1	0.095	0.210	0.212*	0.005	−0.114	−0.042
S_1	0.274**	0.089	0.315	0.313**	0.342**	0.532*
T_1	0.698**	−0.147	0.291	0.173	0.595**	0.203
Constant	5.800	5.897	6.117	5.692	6.478	6.066
$\bar{R}^2$	0.129	0.121	0.165	0.291	0.399	0.355
F	5.84	4.90	8.31	21.70	7.23	16.11
N	263	257	333	455	76	193
Selected mean values						
$\bar{E}$	4.14	5.29	6.09	9.69	11.12	12.51
$\bar{E}_1$	0.26	0.15	0.11	0.00	0.02	0.00

Item	*Unskilled manual* (O_5)	*Semiskilled manual* (O_4)	*Skilled manual* (O_3)	*Junior clerical* (O_{2b})	*Senior clerical* (O_{2a})	*Supervisory* (O_1)
$\bar{E}_2$	0.35	0.23	0.17	0.02	0.00	0.00
$\bar{E}_4$	0.04	0.05	0.13	0.49	0.77	0.43
$\bar{E}_5$	0.00	0.01	0.02	0.11	0.12	0.48
$\bar{V}_1$	0.03	0.13	0.15	0.33	0.25	0.54
$\bar{T}_1$	0.01	0.00	0.01	0.03	0.13	0.10
ln wage ($\bar{W}$)	6.230	6.322	6.750	6.636	7.303	7.517

— A coefficient could not be estimated.

* Statistically significant at the 5 percent level.

**Statistically significant at the 1 percent level.

Note: For definitions of variables, see note to table 6-2.

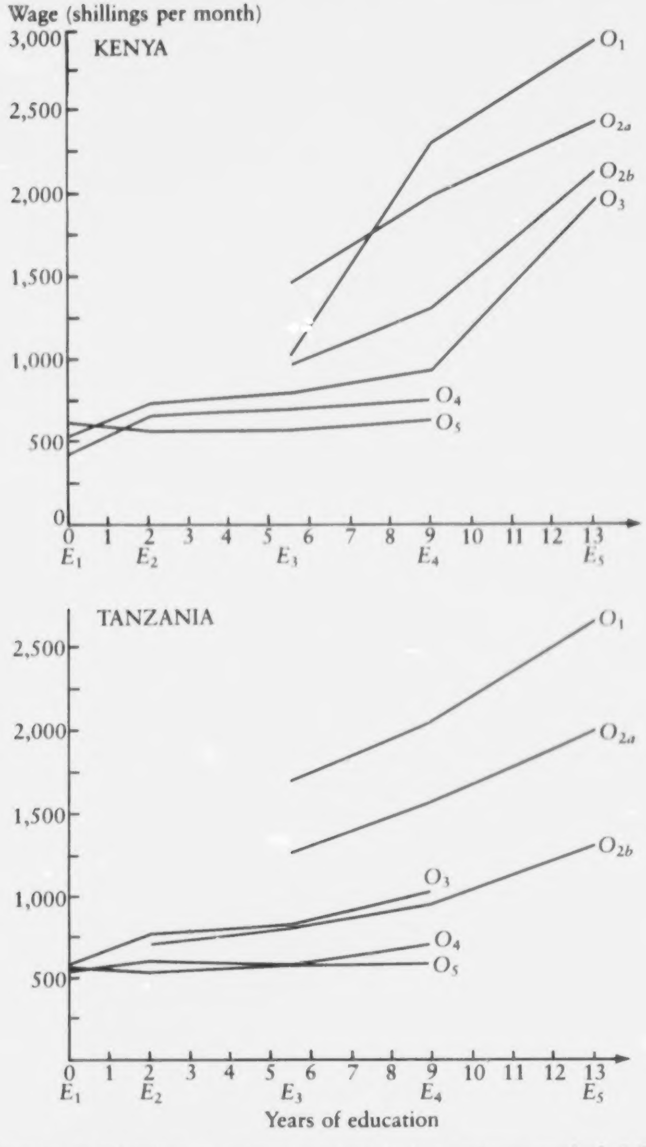
tion for junior clerks in Kenya than in Tanzania. It is apparent from figure 6-1 and table 6-3 that in general the less educated do not enter the more skill-intensive occupations nor the more educated the less skill-intensive occupations. The occupational production functions are such that it would not pay employers to hire the less educated for more skill-intensive jobs or to hire more educated workers for less skill-intensive jobs. Nevertheless, a range of educational levels is found in each occupation, and we would expect the mean educational level within an occupation to rise as the supply of educated labor increases.

The model also predicts that the returns to employment experience will vary among occupations. In figure 6-2, which is analogous to figure 6-1, the occupation-specific wage-experience profiles refer again to a representative worker with the mean characteristics (other than experience) of the sample as a whole. Mean length of experience does not vary greatly or in any regular way among occupations; the mean for the sample as a whole is 11.9 years in Kenya and 10.8 in Tanzania.

In both countries there are positive returns to employment experience in every occupation. These returns are weakest in the unskilled manual category and strongest in the senior clerical category (Kenya) or supervisory category (Tanzania). The main difference lies in the supervisory occupation, where there are strong returns in Tanzania and weaker returns than for the other nonmanual occupations in Kenya. Entry wages in the six occupations differ in rough accordance with the hypothesized skill content, but in addition the wage profiles fan out as employment experience lengthens. Insofar as the absolute height of a curve above the entry wage for unskilled manual jobs can be taken as a measure of skill formation, there is a good deal more skill formation in the nonmanual than in the manual jobs.

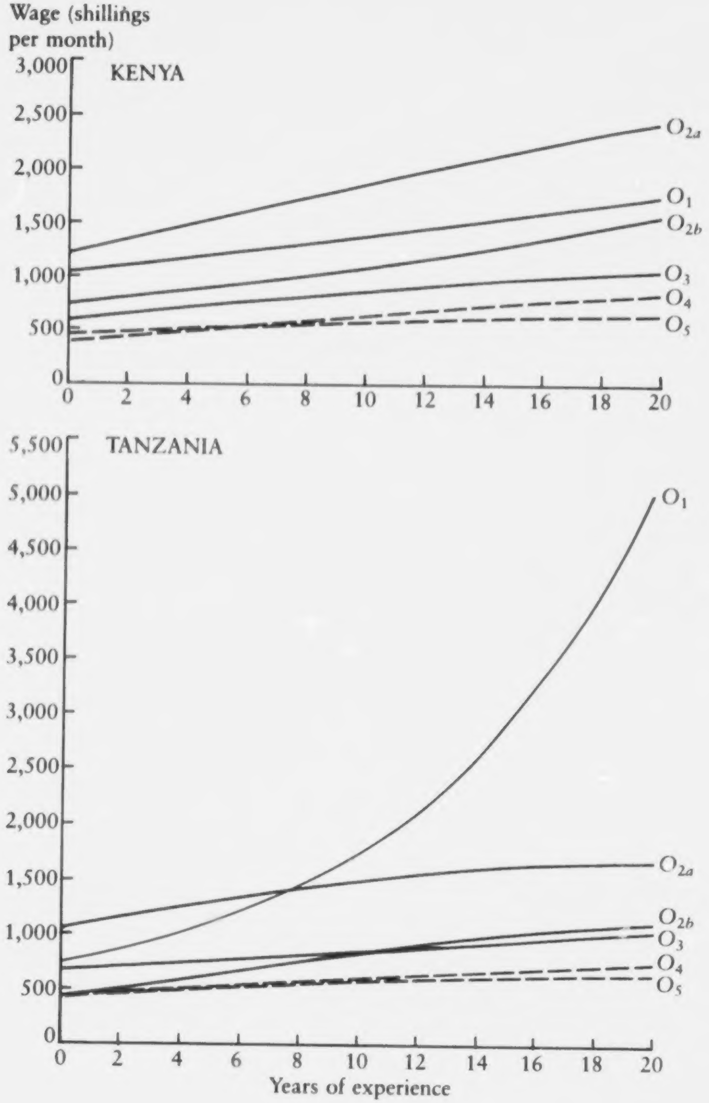
A more detailed analysis was conducted for the subsample of workers whose formal education ended with form 4. An additional variable, D_A

Figure 6-1. *Occupation-Specific Wage, by Educational Level*



Note: E_1, no education; E_2, primary standards 1–4; E_3, primary standards 5–7; E_4, secondary forms 1–4; E_5, post–form 4; O_1, supervisory; O_{2a}, senior clerical; O_{2b}, junior clerical; O_3, skilled manual; O_4, semiskilled manual; O_5, unskilled manual.

Figure 6-2. *Occupation-Specific Wage, by Employment Experience.*



($\lambda = 1 \ldots 4$), was added to the equation to represent the division of pass (the ranked category of scores) on the national form 4 examinations. D_4, the lowest division, is omitted, and D_5 indicates those who failed or did not take the examination. Table 6-4 reports four equations for each country. When occupation terms are added to the basic specification (compare columns 1 and 2), they are generally significant and have precisely the expected ordering in Kenya; four have the expected signs in Tanzania. Their addition as a set adds significantly to the explanatory power of the equation.[6] Again, occupation appears to be an important determinant of wages.

When the division of pass in the form 4 examinations is added to the basic specification (compare columns 1 and 3), the coefficients are significant and have the expected ordering in both countries ($D_1 > D_2 > D_3 > 0 > D_5$). The one exception is the small category D_5 in Tanzania, which is not significantly different from D_4. In Kenya a division 1 graduate earned 130 percent more than a division 4 graduate, other things being equal,[7] and in Tanzania the difference was 68 percent. The addition of the D_λ terms as a set is highly significant.[8] Examination performance, which represents a combination of natural ability and cognitive skill, thus appears also to be important in determining wages. This result holds even for those who left school at the end of form 4; it would be strengthened if allowance were made for the effect of examination performance on access to formal education beyond form 4.

When the variables for examination performance are added to the specification containing occupation (compare columns 3 and 4), the D_λ and O_i coefficients remain significant in Kenya, but most cease to be significant in Tanzania.[9] The spread of both the D_λ and O_i coefficients is reduced, especially in Tanzania, reflecting a positive correlation between examination performance and occupational skill level. In Kenya good scores affect occupational skill level partly by raising pay within occupations and partly by assisting access to preferred occupations; in Tanzania they only assist access. The generally stronger effect of examination performance in Kenya probably reflects the greater abundance of secondary (form 4) leavers in the labor market, which allows Kenyan employers to be more selective than their Tanzanian counterparts.

Occupational Attainment Functions

Even in perfectly competitive factor markets, there should be a positive correlation between the skill intensity of an occupation and the education of its workers. Employers will not hire uneducated workers for a skill-intensive job in which their productivity is lower than the wage that uneducated workers can obtain in unskilled jobs. Educated workers will avoid the unskilled jobs in which their education is less productive and

Table 6-4. *Form 4 Completers: Wage Functions with and without Terms for Occupation and Division of Pass*

Item	*1*	*2*	*3*	*4*
Kenya				
L	0.117*	0.075**	0.111**	0.074**
L^2	−0.0020**	−0.0013**	−0.0017**	−0.0009
V_1	0.040	−0.039	−0.115**	−0.131**
S_1	−0.102	−0.040	−0.143**	−0.075
T_1	0.466**	0.277**	0.249*	0.179
O_1	—	0.884**	—	0.699**
O_{2a}	—	0.630**	—	0.489**
O_{2b}	—	0.321**	—	0.250**
O_4	—	−0.115	—	−0.100
O_5	—	−0.364**	—	−0.346**
D_1	—	—	0.831**	0.525**
D_2	—	—	0.487**	0.267**
D_3	—	—	0.253**	0.105
D_5	—	—	−0.215**	−0.168*
Constant	6.417	6.358	6.298	6.352
$\bar{R}^2$	0.338	0.493	0.429	0.511
F	47.92	45.31	37.76	33.59
N	461	457	441	437
ln wage ($\bar{W}$)	7.153	7.155	7.135	7.136
Tanzania				
L	0.109**	0.079**	0.105**	0.081**
L^2	−0.0019**	−0.0014**	−0.0020**	−0.0014**
V_1	−0.028	0.027	−0.031	−0.018
S_1	0.214**	0.244**	0.157**	0.206**
T_1	0.600**	0.450**	0.464**	0.426**
O_1	—	0.204*	—	−0.179
O_{2a}	—	0.220*	—	0.222
O_{2b}	—	−0.360**	—	−0.312**
O_4	—	−0.579**	—	−0.535**
O_5	—	−0.457**	—	−0.399**
D_1	—	—	0.517**	0.143
D_2	—	—	0.466**	0.243**
D_3	—	—	0.143*	0.032
D_5	—	—	0.097	−0.013
Constant	5.963	6.253	5.854	6.203
$\bar{R}^2$	0.379	0.525	0.426	0.52
F	42.33	37.52	23.38	21.16
N	340	332	272	266
ln wage ($\bar{W}$)	6.891	6.888	6.909	6.906

—Not applicable.

* Statistically significant at the 5 percent level.

**Statistically significant at the 1 percent level.

Note: D_1, division 1; D_2, division 2; D_3, division 3; D_5, failed or did not sit. For definitions of other variables, see notes to tables 6-1 and 6-2. Column numbers identify different regression specifications.

is therefore less highly rewarded. As appendix E shows, if imperfections in the capital and labor markets respectively permit and create occupational wage differences at a given level of education, an element of job competition (rather than wage competition) is introduced as workers with the same education queue for the prized jobs. Moreover, the presence of capital market imperfections, which imply that there are rents to be gained from the acquisition of vocational skills, causes workers of different educational levels to queue for the jobs that offer higher lifetime earnings. Such queues encourage employers to select workers on the basis of their productive characteristics (for example, level of education, examination performance, and the correlate of the first two, ability) or their social characteristics (such as race and sex). Thus, employers are able to minimize the costs of wage rigidity or of rental payments or to indulge a taste for discrimination.

The evidence above suggests that occupations differ in the mean values of some of the personal characteristics of their workers. In particular, occupation, ranked according to hypothesized skill level, is positively correlated with mean educational attainment, receipt of formal training, race, and, in the case of form 4 leavers, examination score. These results are readily understood in the context of our model. Formal training can be viewed as a characteristic of the occupation—that is, as a consequence rather than a cause of occupational choice. The other characteristics, however, can be hypothesized to determine occupation. They are included as explanatory variables in our occupational attainment functions.

Three other explanatory variables are included. Family background, measured by the educational attainment of parents, could represent either job discrimination by employers on the basis of social class or valuable productive traits inherited or acquired from parents. Sex is likely to show job discrimination against women. Length of employment experience could represent either occupational promotion in the course of the worker's career or the state of the labor market when the worker entered it. For instance, in the 1960s a secondary leaver entering the Kenyan labor market could be confident of securing a white-collar job, whereas in the 1980s he was likely to enter a low-level manual job.

The importance of occupational promotion in explaining the influence of length of experience on occupation depends on the degree of occupational mobility in the sample. Our data include occupation at the end of the previous job and at the end of the first job, but since only 43 percent of Kenyans and 36 percent of Tanzanians had ever changed employers, information on previous jobs covers only a minority of respondents. We also lack information on occupational mobility during the tenure of the current job. Nevertheless, the evidence that we do have is suggestive.

In Kenya, among the minority on whom we have information about more than one job, 62 percent of job moves involved no change of occupation, 22 percent were upward on our occupational scale, and 16 percent were downward. The most frequent occupational changes were from junior to senior clerical and from unskilled to semiskilled manual (more than 4 percent of all job changes in each case) and from semiskilled up to skilled and down to unskilled manual (nearly 4 percent in each case). In Tanzania, where there were even fewer recorded job moves, 73 percent were within the same occupational group, 19 percent were upward on the occupational scale, and 8 percent were downward. The most frequent occupational changes were again from junior to senior clerical (more than 5 percent of all job changes but only 20 percent of job changes by junior clerks), from unskilled to semiskilled manual (nearly 3 percent), and from semiskilled to junior clerical (nearly 3 percent).

We conclude that mobility among occupations, insofar as we can measure it, is decidedly low. The initial allocation to an occupational group appears to stick in a high proportion of cases. Because of rapid educational expansion in recent years, we hypothesize that earlier entry into the labor market means better occupational chances. This relationship should be best observed within an educationally homogenous group.

We analyze occupational attainment within the framework of a multinominal logit model in which access to occupation O_i, in relation to the base occupation, is explained in terms of a vector of personal characteristics (following the method of, for instance, Schmidt and Strauss 1975). The supervisory occupation (O_1) is chosen as the base for the purpose of normalization. Education is entered in the dummy variable form with E_1, no education, as the base, and family background (F) is entered as a cardinal variable with values of 0 if both parents have no education, 1 if one parent has no education and the other has primary education, 2 if one has no education and the other has secondary education, and 3 if both parents have some education.

We estimate five functions of the form:

$$(6\text{-}4) \quad \ln(P_i/P_1) = a_i + \Sigma\, b_{ik}E_k + c_iL + d_iF + e_iS_1 + f_iT_1 + u_i$$

where P_i/P_1 is the ratio of the probability of being in occupation O_i to that of being in O_1. A comparison of, say, O_4 and O_3 can be derived as:

$$\begin{aligned}(6\text{-}5) \quad \ln(P_4/P_3) \quad = \quad & \ln(P_4/P_1) - \ln(P_3/P_1) = a_4 - a_3 \\ & + \Sigma\,(b_{4k} - b_{3k})E_k + \dots + (f_4 - f_3)T_1 + u_4 - u_3\end{aligned}$$

Since we generally expect each of the independent variables to improve occupational attainment (in relation to the omitted category in the case of the dummy variables) and since we order occupations as $O_1 > O_{2a} > O_{2b} > O_3 > O_4 > O_5$, our general expectation is that b_{ik}, c_i, d_i, e_i, and f_i

are all negative; similarly, that the differences $b_{(i+1)k} - b_{ik}$, $c_{i+1} - c_i$, . . . $f_{i+1} - f_i$ are negative. Since any extension of education should improve occupational attainment, not only is b_{ik} negative, but also $b_{i2} > b_{i3} > \ldots > b_{i5}$ in algebraic terms.

Table 6-5 sets out our maximum likelihood estimates. The significant negative coefficient on L in occupation O_{2b}, for instance, is interpreted as follows: an additional year of employment experience reduces the probability of having a junior clerical rather than a supervisory job. Apart from the senior clerical occupation in Kenya, the coefficients on employment experience are all significantly negative and become mono-

Table 6-5. *Multinomial Logit Model of Occupational Attainment*

Item	*Senior clerical* (O_{2a})	*Junior clerical* (O_{2b})	*Skilled manual* (O_3)	*Semiskilled manual* (O_4)	*Unskilled manual* (O_5)
Kenya					
Level of education					
E_2	6.174	7.684	−0.231	−0.091	−1.195
E_3	0.367	1.044	−8.119	−9.465	−10.368
E_4	0.667	0.434	−10.507	−11.862	−12.935
E_5	1.386	−1.883	−13.320	−23.420	−24.365
L	0.017	−0.084**	−0.092**	−0.118**	−0.175**
F	−0.155	−0.484**	−0.508**	−0.552**	−0.791**
S_1	−1.359**	−1.286**	2.033**	−0.642	−0.404
T_1	−0.791	−1.257**	−3.404**	−1.588*	−9.720
Constant	0.838	3.698	10.812	14.427	15.980
Tanzania					
Level of education					
E_2	−7.196	1.102	−0.703	−0.729	−0.948
E_3	−8.594	−5.119	−8.239	−8.784	−10.075
E_4	−8.401	−6.987	−11.911	−13.387	−14.189
E_5	−10.445	−8.891	−14.559	−15.288	−24.128
L	−0.050*	−0.112*	−0.125**	−0.152**	−0.199**
F	−0.021	0.072	−0.274*	−0.300*	−0.452**
S_1	−1.180**	−0.036	4.527**	1.764**	0.535
T_1	0.524	−1.449**	−0.664	−2.233	−0.956
Constant	9.426	9.217	8.767	12.067	14.393

* Statistically significant at the 5 percent level.

**Statistically significant at the 1 percent level.

Notes: E_3, primary standards 5–7; F, family background, as a continuous variable. For definitions of other variables, see note to table 6-2. For Kenya: $\chi^2 = 1{,}253$; percentage of predictions correct = 45; percentage of predictions correct or contiguous = 74; $N = 1{,}684$. For Tanzania: $\chi^2 = 1{,}434$; percentage of predictions correct = 48; percentage of predictions correct or contiguous = 78; $N = 1{,}574$.

tonically more negative as occupations become less skilled; earlier entry to the labor market improves current occupational attainment. The coefficients on educational level (in relation to no education) are not significant, but they display a clear pattern. Within each occupation the coefficient on educational level becomes algebraically smaller as the educational level rises, and for each educational level there is a tendency for the coefficient to be smaller in the less skilled occupations.[10] More education reduces the probability of being in a less skilled as against a supervisory job, and the reduction tends to be greater the lower is the skill level of the job under consideration.

In both countries women tend to be excluded from the highest manual category (skilled) and the highest nonmanual category (supervisory). The family background coefficients are mostly significantly negative, and their algebraic value tends to be directly correlated with occupational rank; the better educated are a worker's parents, the better are his chances of being in a good job. In Kenya the coefficients on non-African race are mostly significantly negative and tend to become more negative as we move down the occupational hierarchy; being non-African improves a worker's occupational chances. In Tanzania the non-African coefficients generally have the expected sign, but the results are weaker.

Both equations perform reasonably well. The chi-squared test against the null hypothesis that the coefficients are zero is significant at the one-in-a-million level. Moreover, the coefficients generally make good economic sense. In Kenya the model predicts the correct occupation (in the sense that the most likely occupation corresponds to the actual occupation) in 45 percent of all cases and in Tanzania in 48 percent. The model predicts either the correct occupation or a contiguous one in our hypothesized occupational skill hierarchy in 74 and 78 percent of the cases, respectively.

Table 6-6 shows how the probability that a representative worker will be in a particular occupation varies according to level of education and time of entry into employment (which corresponds to years of employment experience). In both countries the skill ranking of the most probable occupation rises (apart from a couple of equalities) with level of education. In both countries the probability of being an unskilled manual worker falls monotonically and sharply as educational attainment rises, whereas the probability of being in each of the nonmanual occupations rises almost monotonically with educational level. (The exception is those with education beyond form 4; for them the supervisory occupation dominates.) A worker's educational level is thus an important determinant of his occupation.

The table also permits us to examine filtering down—the movement of educated workers or of educated entrants to the labor market into lesser jobs as a result of an increased supply of educated labor. The prob-

Table 6-6. *Predicted Probabilities of Occupational Attainment, by Level of Education and Year of Entry to Employment*

Item	*Supervisory* (O_1)	*Senior clerical* (O_{2a})	*Junior clerical* (O_{2b})	*Skilled manual* (O_3)	*Semi-skilled manual* (O_4)	*Unskilled manual* (O_5)
Kenya						
Level of education						
E_1	0.00	0.00	0.00	0.12	0.22	0.66
E_2	0.00	0.00	0.02	0.19	0.40	0.40
E_3	0.01	0.01	0.13	0.41	0.20	0.24
E_4	0.06	0.09	0.41	0.22	0.11	0.11
E_5	0.50	0.09	0.31	0.10	0.00	0.00
Year of entry into employment						
Primary standards 5–7 (E_3)						
1980	0.00	0.00	0.08	0.28	0.19	0.45
1970	0.01	0.01	0.12	0.39	0.20	0.27
1960	0.03	0.03	0.15	0.47	0.18	0.14
Secondary forms 1–4 (E_4)						
1980	0.02	0.02	0.34	0.20	0.14	0.28
1970	0.05	0.07	0.40	0.22	0.11	0.13
1960	0.12	0.19	0.38	0.19	0.07	0.05
Tanzania						
Level of education						
E_1	0.00	0.00	0.00	0.22	0.28	0.50
E_2	0.00	0.00	0.03	0.24	0.30	0.43
E_3	0.01	0.00	0.17	0.39	0.29	0.14
E_4	0.17	0.09	0.47	0.18	0.05	0.04
E_5	0.58	0.04	0.23	0.04	0.10	0.00
Year of entry into employment						
Primary standards 5–7 (E_3)						
1980	0.00	0.00	0.12	0.31	0.31	0.26
1970	0.01	0.00	0.16	0.38	0.29	0.15
1960	0.03	0.01	0.21	0.43	0.25	0.08
Secondary forms 1–4 (E_4)						
1980	0.05	0.05	0.49	0.22	0.08	0.11
1970	0.16	0.08	0.47	0.18	0.06	0.05
1960	0.37	0.12	0.35	0.12	0.03	0.01

Note: For definitions of variables, see note to table 6-2. The probabilities are those for a worker with modal values for the characteristics sex, race, and family background (male, African, and uneducated parents). In the analysis by level of education the mean values of employment experience (11.9 years in Kenya and 10.8 years in Tanzania) are assumed; in the analysis by year of entry into employment the assumed educational level is specified.

abilities of occupational attainment are shown for three different cohorts of primary and secondary leavers—those who entered the labor market in 1960, 1970, and 1980. For primary leavers the semiskilled manual occupation is pivotal in both countries; later entry decreases the probability of securing a better job and sharply increases the probability of entering an unskilled job. For secondary leavers the junior clerical and skilled manual occupations are pivotal in Kenya, whereas in Tanzania the dividing line is between senior and junior clerical. The fact that the probabilities of occupational attainment differ from one cohort to another suggests that the burden of filtering down falls on entrants to the labor market rather than on incumbents. The time at which a worker entered wage employment is an important determinant of his occupation.

Consider the most recent cohort, which entered wage employment at the time of the surveys. The probability that a new secondary leaver will enter a semiskilled or unskilled manual job is 42 percent in Kenya but only 19 percent in Tanzania, where the probability that such a person will enter a nonmanual job is 61 percent. The probabilities of occupational attainment of new primary leavers are similar in the two countries, which have similar government policies on primary education. The contrast arises at the secondary level; the filtering down of entrants has proceeded further in Kenya than in Tanzania, which reflects the far more rapid expansion of secondary education in Kenya.

The determinants of the occupational attainment of secondary leavers are shown in table 6-7. The equations perform well as measured by the chi-squared test and the number of bull's-eyes and near-misses, although half of their coefficients are not significantly different from zero. The Tanzanian specification had to be simplified to obtain convergence on a set of coefficients. In Kenya the discrimination variables, although not significant, generally show the expected pattern; the coefficients tend to become more negative as occupations become less skilled: parents' education and non-African race improve occupational attainment. In both countries the significance, sign, and pattern of the employment experience coefficients are generally as expected; earlier entry into the labor market improves occupational attainment.

Table 6-8, which is analogous to table 6-6, illustrates how the expansion of education has affected filtering down. The junior clerical occupation is pivotal for secondary leavers; for more skilled occupations the probability of access is lower for later entrants, whereas for less skilled occupations the probability is higher. Although fewer than half of the coefficients are significant (table 6-7), a pattern can be discerned that is best illustrated by examining probabilities (table 6-8). The probability of access to supervisory and senior clerical jobs improves with examination performance in both countries. In Kenya the chances of landing in an unskilled or semiskilled manual job rise sharply as examination perfor-

Table 6-7. *Multinomial Logit Model of Occupational Attainment of Form 4 Leavers*

Item	*Senior clerical* (O_{2a})	*Junior clerical* (O_{2b})	*Skilled manual* (O_3)	*Semiskilled manual* (O_4)	*Unskilled manual* (O_5)
Kenya					
L	0.033	−0.116**	−0.164**	−0.338**	−0.607**
D_1	−2.504	−3.489**	−14.149	−13.669	−5.004**
D_2	−1.444	−2.741**	−3.691**	−4.473**	−13.098
D_3	−1.563	−2.232*	−2.708**	−2.846*	−4.821**
D_5	7.731	8.237	6.370	8.616	9.561
F	0.382	−0.074	−0.253	−0.612*	−0.829**
T_1	−1.299	−1.018	−10.315	8.686	6.724
Constant	0.966	4.914**	4.454**	5.245**	7.004**
Tanzania					
L	−0.074*	−0.130**	−0.146**	−0.643	−0.500*
D_1 or D_2	0.402	−1.062**	0.463	−8.190	−8.808
Constant	0.036	2.246**	0.015	1.248	1.351

* Statistically significant at the 5 percent level.

**Statistically significant at the 1 percent level.

Note: For definitions of variables, see note to table 6-2. A solution could not be obtained when any more independent variables, in isolation or in combination, were added to the specification for Tanzania. For Kenya: $\chi^2 = 256$; percentage of predictions correct = 50; percentage of predictions correct or contiguous = 78; $N = 452$. For Tanzania: $\chi^2 = 72$; percentage of predictions correct = 53; percentage of predictions correct or contiguous = 73; $N = 255$.

mance deteriorates, whereas in Tanzania, where secondary leavers remain scarce, the less well-qualified secondary leavers are absorbed mainly into junior clerical jobs.

The analysis of the occupational attainment of secondary leavers is instructive for two reasons. First, given a lack of mobility both among jobs and among occupations, we would expect entrants to the market to bear the brunt of labor market adjustment to educational expansion. The results suggest that educated entrants have indeed been filtering down into jobs that reward their skills less well and offer less scope for further acquisition of skills. The reverse of the coin is that there has been a process of human capital deepening, so that productivity has increased within each occupation (but to a smaller extent in the less skilled occupations). Second, the importance of examination performance in determining occupational attainment suggests that employers choose workers with the most natural ability and cognitive skill for the jobs that make the best use of these qualities and provide the most scope for their combination with vocational skills.

Table 6-8. *Predicted Probabilities of Occupational Attainment of Form 4 Leavers, by Examination Performance and Year of Entry into Employment*

Item	*Supervisory* (O_1)	*Senior clerical* (O_{2a})	*Junior clerical* (O_{2b})	*Skilled manual* (O_3)	*Semi-skilled manual* (O_4)	*Unskilled manual* (O_5)
Kenya						
D_1	0.34	0.10	0.55	0.00	0.00	0.02
D_2	0.17	0.14	0.58	0.10	0.02	0.00
D_3	0.10	0.08	0.58	0.15	0.07	0.01
D_4	0.01	0.03	0.54	0.23	0.12	0.08
D_5	0.00	0.02	0.51	0.03	0.16	0.28
Year of entry into employment						
1980	0.02	0.01	0.35	0.14	0.26	0.21
1970	0.13	0.10	0.58	0.14	0.05	0.00
1960	0.27	0.29	0.38	0.06	0.00	0.00
Tanzania						
D_1 or D_2	0.31	0.24	0.31	0.13	0.00	0.00
Other	0.21	0.11	0.61	0.06	0.00	0.01
Year of entry into employment						
1980	0.05	0.05	0.48	0.05	0.18	0.20
1970	0.25	0.11	0.60	0.05	0.00	0.01
1960	0.50	0.12	0.35	0.03	0.00	0.00

Note: For definitions of variables, see note to table 6-2. The probabilities are those of a form 4 completer with mean values of employment experience (8.2 years in Kenya and 9.0 in Tanzania) and modal values of the other characteristics.

As a final exercise we combine the earnings functions of table 6-2 and the predicted probabilities of table 6-6 to estimate the combined direct and indirect effects of secondary education on earnings. The coefficient on E_4 (secondary forms 1–4, with E_3, primary standards 5–7, as the base category) in table 6-2, column 3, shows that in the simple earnings function secondary education adds 62 percent to earnings in Kenya and 44 percent in Tanzania.[11] To estimate the effect of secondary education on earnings with the use of the earnings function that contains occupation terms (column 4), we have to combine the direct effect (obtained from the coefficient on E_4) and the indirect effect (through occupational attainment).

The indirect effect is estimated as follows. For a representative worker with the mean values of the explanatory variables (other than educational level) for the sample as a whole, we predict the probability of being in each occupation if he is a primary leaver and if he is a secondary leaver. From the sum of the occupation coefficients weighted by the predicted probabilities for secondary leavers of being in the different occupations, we subtract the sum of the coefficients weighted by the predicted probabilities for primary leavers. This net term therefore shows the addition to earnings that secondary education makes by improving occupational chances.

The coefficient on E_4 is reduced by over half by the introduction of the occupation terms, but the indirect effect of secondary education almost precisely makes up for this. The increase in earnings attributable to the combined direct and indirect effects is 67 percent in Kenya and 49 percent in Tanzania.[12] It is therefore not part of our argument that the effect of education on earnings is weakened by the influence of occupation. Rather, our argument is that the main part of that effect can arise from the influence of education on occupational attainment. Our ability to decompose into its direct and indirect effects the influence that education has on earnings will be used in the analysis of the dynamic effects of educational expansion in chapters 8 and 14.

Conclusions

Akerlof (1981) views jobs as "dam sites" not to be underutilized—that is, not to be filled by workers whose productivity is too low. We view jobs more as "factories"—that is, each occupation is a production unit with its own production function for converting inputs into outputs. In factories that are more complex and technologically advanced than others, there is a nexus of relationships between output and the inputs of labor, cognitive skill, vocational skills, and natural ability such that these inputs are found in combination and yield high returns.

The East African results, which are the more impressive because of their replicability, are consistent with our model of the role of occupation. The addition of occupation terms to the earnings function is statistically significant, and their coefficients correspond to our hypothesized ordering by skill level. When we compare occupational earnings functions, we find that the returns to the human capital variables, education and employment experience, generally increase with hypothesized skill level. The occupation in which a worker is employed has an important effect on both the level of his pay and the responsiveness of his pay to changes in his characteristics.

The determinants of occupational attainment are education, employment experience, race, sex, and family background. The findings on education suggest that, given the scarcity of education in East Africa, employers prefer to recruit the most educated workers available for the jobs that attract scarcity rents. The results on the examination performance of secondary leavers imply that employers do so for economic rather than social reasons. The role of social characteristics in occupational access, however, suggests that there is also an element of discrimination. Employment experience could represent occupational promotion over the course of a worker's career or the state of the labor market at the time of his entry into it. The remarkably low degree of upward occupational mobility revealed by the surveys suggests that the initial allocation to an occupation can govern lifetime earnings and that the date of that allocation is important.

Although it would be possible to drop occupation and consider a reduced form earnings equation that combined the determinants of occupational attainment and of earnings, we gain insight by keeping the two processes separate. This can be illustrated in a dynamic context. Education alters the wage by influencing both the wage within an occupation and occupational attainment. An earnings function that excludes occupation will measure these combined effects. If educational expansion occurs, its effect will be shown in a subsequent earnings function, with occupation again excluded, as a fall in the return to education. But educational expansion produces a change in the education-occupation matrix. A form 4 leaver, for instance, now becomes a factory operative, whereas previously he would have entered an office job; his education, although still valuable, is not as valuable as it would have been before expansion. By introducing occupation we can better understand the mechanism by which the return to education falls and, more generally, the way in which the labor market operates. This method will be employed in chapters 8 and 14.

When the rate of return to skill acquisition exceeds the discount rate, access to skills raises lifetime earnings. The way in which skills are then rationed is relevant for both efficiency and equity. The nexus of relationships which we have postulated and for which we have found empirical support suggests that natural ability and access to formal education are important to occupational attainment and thus to vocational skill acquisition. In a meritocratic educational and social system that provides equality of opportunity, positive interaction among the determinants of earnings contributes to economic efficiency. Even in a meritocratic system, however, the interaction accentuates income inequality among workers.

Our conclusions are open to at least two criticisms. First, it might be argued that in the empirical analysis occupation simply acts as a proxy for the unmeasured personal characteristics, such as natural ability, that influence wages and that it has no causal effect on wages. We accept that a positive correlation between occupation and ability, which is indeed predicted by our model, may exaggerate the role of occupation in the wage determination equation, but that does not mean that occupation has no effect. An explanation in terms of correlation has to account for such correlation, and that in turn requires the occupational production function model. Second, our interpretation of occupation as representing the acquisition of occupation-specific skills can be questioned; occupation might at least in part represent payments according to position in a status hierarchy (see, for instance, Lydall 1968, pp. 126–33), which inevitably overlaps with a skill-based ordering. Yet a full explanation in terms of status would have to account for the differing returns to education and experience among occupations, which are satisfactorily captured in our skill-based model.

The problems of specification and interpretation mean that the results are suggestive rather than conclusive. We suggest that in East Africa, and quite likely elsewhere, occupation should be cast in a role on center stage rather than remain an understudy in the wings.

Notes

1. The omitted categories among the dummy variables are V_2 (no formal training), S_2 (female sex), T_2 (African race), and O_3 (skilled manual occupation).

2. The *F*-test statistic for inclusion of the occupation terms is 72 in Kenya and 70 in Tanzania, well above the critical value of 3.04 for significance at the 1 percent confidence level.

3. The values of *F* are 5.21 in Kenya and 3.31 in Tanzania, the critical value being 2.04. A $V_1 \cdot O_i$ interaction term was not included in the interaction equation for the reasons explained in note 5, below.

4. The values of *F* are 11.86 and 3.28 in Kenya and Tanzania, respectively (the critical value being 3.02), when the education interaction terms are omitted, and 3.61 and 4.13, respectively (critical value 2.32), when the experience interaction terms are omitted.

5. A significant positive effect may be lacking because this variable was too narrowly defined; the relevant concept is possession of formal training, whereas the question asked whether the current employer had provided formal training. Moreover, training courses are heterogeneous and it is difficult to convert them to full-time-equivalent training.

6. The values of *F* are 28.6 in Kenya and 21.0 in Tanzania, the critical value for significance at the 1 percent level being 3.36.

7. $100[\exp(0.831) - 1] = 130$. See Halvorsen and Palmquist (1980), p. 474.

8. The values of *F* are 18.4 in Kenya and 6.8 in Tanzania, the critical value for significance at the 1 percent level being 3.83.

9. The values of *F* are 5.14 in Kenya and 0.33 in Tanzania, the critical value for significance at the 1 percent level being 3.83.

10. When years of education (*E*) is used in the occupational attainment func-

tion instead of the dummy variables (E_k), the coefficient on E is significantly negative in every case and there is a monotonic decrease in the algebraic value of the coefficient as the hypothesized occupational skill level falls. The coefficients of the other independent variables are only trivially altered by the substitution.

11. $100[\exp(0.480) - 1] = 62$ and $100[\exp(0.364) - 1] = 44$.

12. The difference between the two methods of 5 percentage points in each country (67 − 62 and 49 − 44) arises because the other determinants of occupational attainment also come into play owing to collinearity with educational level; their net effect, however, is slight.

CHAPTER 7

Educational Expansion, Government Pay Policy, and Wage Compression

The underlying assumption of part III is that the relative expansion of secondary education depresses the earnings premium that the market places on education. Our main concern is to examine the extent to which educational expansion compresses the earnings structure by education —that is, the elasticity in the response of relative wages to relative supply. The relationship between wages and the supply of educated labor has long been recognized. It was perceived to be operating powerfully in nineteenth-century Britain (Mill 1848, II, p. xiv. 2), it has been held responsible for the decline in average salaries in relation to wages that has been taking place in Britain and the United States since the 1930s (Phelps Brown 1977, pp. 81–89), and it has been singled out as the principal policy tool available for narrowing the structure of earnings (Lydall 1968, pp. 254–66).

The elasticity of substitution (σ) between two educational levels has been the subject of study[1] because of its relevance not only to the consequences of educational expansion for economic growth but also to the choice between the manpower requirements approach to educational planning and the rate of return approach. The higher is the value of σ, the greater is the potential contribution of rapid expansion to growth—and therefore the less appropriate is the manpower requirements approach, with its assumption of fixed coefficients between educational and occupational levels, and the more appropriate is the rate of return approach. In fact, σ is simply the reciprocal of the parameter we are seeking.

Part III also examines the way in which the labor market adjusts to

Note: Adapted from J. B. Knight and R. H. Sabot, "Educational Expansion, Government Policy and Wage Compression," *Journal of Development Economics* 26, no. 2 (August 1987), pp. 201–21.

educational expansion. We have already analyzed the role of occupation in the determination of wages and in market adjustment to educational expansion. A second issue concerns the degree of competitiveness of the labor market and the nature and effectiveness of government pay policies. Does the additional payment for secondary education reflect the market forces of supply of and demand for the educated, or does it reflect the influence that government intervention has on the wage structure? This analysis should improve our understanding of the operation of labor markets in Kenya and Tanzania. Chapter 7, which is concerned with isolating the effect that institutional intervention by the government has on wages, paves the way for isolating the effect of educational expansion on wages in chapter 8.

The analysis again exploits the natural experiment. In particular, we examine the effects on relative wages of the difference in the educational composition of the wage labor forces in Kenya and Tanzania caused by the large difference in secondary enrollments. In addition to using the two surveys administered in 1980, we employ a similar survey of the manufacturing sector in Tanzania that was conducted by one of the authors in 1971. A comparison of this survey with the manufacturing subsets for 1980 permits time series as well as cross-country analysis. We also use a national urban household survey, conducted by one of the authors in 1971 (Sabot 1979), to assess changes in government pay policy in Tanzania during the 1970s. The three manufacturing samples, the 1971 wage sector sample, and the two wage sector samples for 1980 provide six data sets in all.

The Problem and Two Hypotheses

Our specific objective is to measure η_{sp}, the elasticity of the relative earnings of secondary and primary leavers with respect to the expansion of secondary in relation to primary leavers in the wage-labor market.

$$\eta_{sp} = \frac{1}{\sigma_{sp}} = \frac{\partial Y}{\partial S} \cdot \frac{S}{Y} = \frac{\partial(\ln Y)}{\partial(\ln S)} \tag{7-1}$$

where

Y = w_s/w_p
S = L_s/L_p
w_i = mean earnings of educational group i, when other personal characteristics are standardized
L_i = number of employees with educational attainment i
i = s, p

s = secondary leavers
p = primary leavers
σ_{sp} = elasticity of substitution between educational groups s and p
η_{sp} = elasticity of relative earnings with respect to the expansion of educational group s in relation to p

The premium on secondary education (π) is defined as the proportional increase in earnings provided by secondary education when other characteristics are standardized.[2]

The method that has generally been employed to measure σ (and implicitly η) is to estimate a relationship from cross-country or cross-section data on the ratios of employment and of earnings for different educational levels.[3] The model underlying this method is that

$$Y = Y(S) \tag{7-2}$$

that is, the relative wage is a function solely of relative supply. In figure 7-1 the curve $D_{K,T}$ shows the relative demand for secondary leavers in response to variation in the relative wage. An exogenous shift in the rela-

Figure 7-1. *The Premium to Secondary Education as a Function of Relative Labor Supply and Pay Policy*

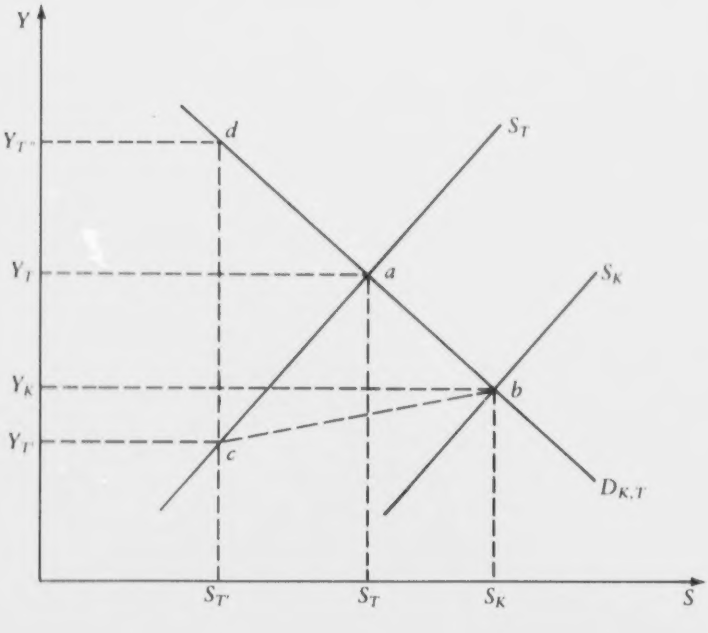


Table 7-1. *Estimates of η_{sp} Derived from the Educational Structure of Employment and Wages Standardized for Personal Characteristics*

Item	*Manufacturing*			*Wage sector*	
	Tanzania 1971	*Tanzania 1980*	*Kenya 1980*	*Tanzania 1980*	*Kenya 1980*
A. Employment by educational level (percentage of total)					
Standards 5–7 (E_3)	36.5	48.4	45.6	38.6	33.8
Forms 1–4 (E_4)	10.3	16.0	33.6	26.7	39.9
Forms 1–4 (E_4) (E_3 = 100)	28.2	33.3	73.7	69.2	116.9
B. Mean wage by educational level (shillings per month)					
Standards 5–7 (E_3)	318	664	913	806	933
Forms 1–4 (E_4)	964	1,352	1,141	1,210	1,409
Forms 1–4 (E_4) (E_3 = 100)	303	204	125	150	151
C. Coefficient on E_4 and index with E_3 = 100 in simple earnings function with ln earnings as dependent variable[a]					
Forms 1–4 (E_4) (E_3 omitted)	0.748	0.502	0.256	0.376	0.472
Forms 1–4 (E_4) (E_3 = 100)	211	165	129	146	160
η_{sp}	−1.48	−0.31		0.18	

a. The other independent variables, which are not reported in the table, are the three other educational categories, employment experience and its square, and dummy variables that represent race, sex, employment status, and formal training.

tive supply curve (from S_T to S_K) in a competitive market reduces the relative wage from Y_T to Y_K.

Parts A and B of table 7-1 are used to derive estimates of η_{sp} based on the conventional method for the manufacturing sector and for the wage sector as a whole in each country. The supply of secondary in relation to primary education is markedly higher in Kenya than in Tanzania in both the wage sector as a whole and in the manufacturing sector. In Tanzania's manufacturing sector relative supply is higher in 1980 than in 1971.

The three manufacturing samples may be thought of as representing three points in a time series: Tanzania 1971, Tanzania 1980, and Kenya 1980, which is equivalent to Tanzania some years hence. The values of η_{sp} obtained for manufacturing (−2.38 between Tanzania 1971 and Tanzania 1980 and −0.62 between Tanzania 1980 and Kenya 1980) have the expected negative sign. The positive elasticity of 0.01 obtained for the wage sector as a whole presents us with an anomaly, however. This association of a higher relative supply of secondary leavers in the labor force with a higher relative wage might be attributable simply to differences between Kenyan and Tanzanian employees in the other personal characteristics that influence wages.[4] But when we use standardized premiums earned by secondary leavers, as derived from the simple earnings functions (part C of table 7-1), the same pattern emerges: −1.48 and −0.31 for the manufacturing sector and +0.18 for the wage sector. The shift to the standardized premiums actually makes the estimated elasticity more positive.

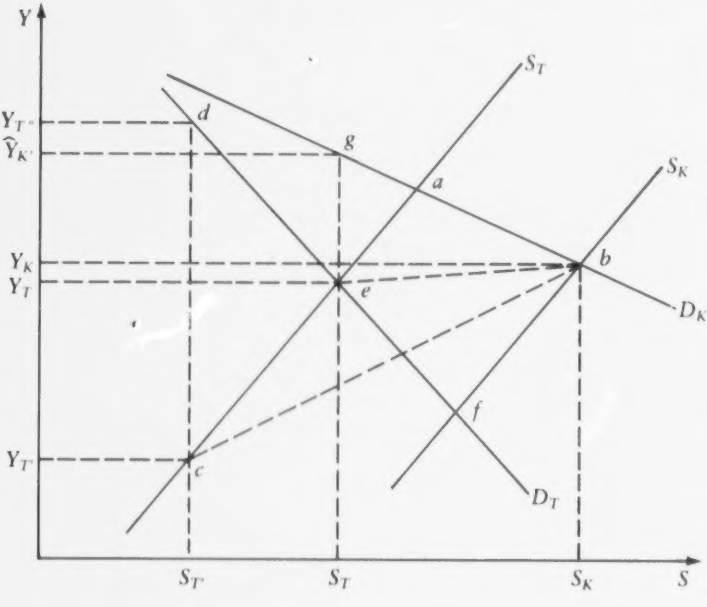
The explanation for these anomalous results may lie in a misspecification of the model that underlies the conventional method. Differences between two countries in institutional interventions, such as government pay policies, or in relative demand functions, as well as in their supply functions, could affect the educational structure of wages, and hence η_{sp}. Rather than $Y = Y(S)$, the appropriate specification might be

$$Y = Y(S, G, D) \tag{7-3}$$

where G is the effect that the intervention has on the premium and D represents differences in relative demand. Figures 7-1 and 7-2 illustrate two alternative hypotheses.

Despite the relative scarcity of secondary leavers in Tanzania, the premium on secondary education may be lower there than in Kenya because of the equalizing effect of government pay policy. If the impact of pay policy is greater the higher is the position of the worker on the earnings scale, the premium to secondary education is compressed below the competitive level—for example, from Y_T to $Y_{T'}$ in figure 7-1. As drawn, $Y_{T'} < Y_K$. An estimate of η_{sp} that did not eliminate the influence of pay policy

Figure 7-2. *The Premium to Secondary Education as a Function of Relative Labor Supply and Demand and of Pay Policy*



would compare points *c* and *b*. It would therefore overestimate the elasticity derived from a comparison of points *d* and *b*.

Alternatively, despite the relative scarcity of secondary leavers in Tanzania, the premium on secondary education is lower there because for any given level of supply in the relevant range, relative demand is greater in Kenya than in Tanzania. If differences in sectoral composition or in technology cause production to be more skill-intensive in Kenya, the labor demand function will be farther to the right in Kenya (D_K in figure 7-2) than in Tanzania (D_T). At Tanzania's level of supply (S_T) the premium on secondary education is shown to be higher in Kenya ($\hat{Y}_K$) than in Tanzania (Y_T). An estimate of η_{sp} that did not take account of differences in relative demand would compare points *e* and *b* and would again overestimate the elasticity derived from a comparison of *e* and *f* for Tanzania and of *a* and *b* for Kenya. It would be positive.

If both hypotheses apply, an estimate of η_{sp} that took account neither of wage distortions nor of differences in relative demand would be based on a comparison of points *c* and *b* in figure 7-2. It would overestimate the true elasticity in both countries and could have the wrong sign.

Government Pay Policy in Kenya and Tanzania

In the period immediately following independence in Tanzania average wages were substantially higher in the public sector than in the private sector. Because the public sector specializes in providing services, its demand for labor is relatively skill-intensive. In 1971 about 51 percent of urban workers employed by the government had white-collar occupations, whereas only 10 percent of workers in the private sector were in such jobs. As a consequence the educational attainment of government employees exceeded that of their private sector counterparts. About 28 percent of government employees had postprimary schooling, compared with 6 percent of private sector employees.

This difference in labor force composition does not, however, account for all of the intersectoral wage differential. We used the 1971 national urban household survey to estimate earnings functions that standardized for human capital endowments. The results below are drawn from Lindauer and Sabot (1983) and from appendix G. Because the data are based on a household survey, they are not strictly comparable with those from our establishment survey. The results are nevertheless indicative. Average wages were 51 percent higher in the government than in the private sector in 1971 (table 7-2). About 27 percent of the gross wage differential between the government and private sectors was not explained by differences in the mean values of characteristics of the two groups. A gov-

Table 7-2. *Mean Wages and Gross Wage Differentials, by Ownership Category, Tanzania, 1971*
(shillings per month)

		Gross wage differential		
Item	*Mean wages*	*Total*	*Attributable to differences in characteristics*	*Residual*
Private (J_1)	263	—	—	—
Government (J_2)	396	—	—	—
Parastatal (J_3)	409	—	—	—
Government − private	—	133	97	36
Parastatal − private	—	144	71	73
Parastatal − government	—	13	−9	22

— Not applicable.

Note: The part of the gross wage differential that is attributable to differences in characteristics is the mean estimate obtained from the two alternative decomposition formulas.

Source: Lindauer and Sabot (1983), table 7.

ernment employee thus received about 13 percent more than he would have received in the private sector.

Government pay policy provides one explanation for the public sector premium observed in 1971. The government's role as wage leader and its aim of raising wages were first outlined by the East African Royal Commission in 1955. In the commission's view the migrant labor system that prevailed in Kenya and Tanganyika (now Tanzania) led to inefficient use of labor both in agricultural self-employment and in wage employment. A rise in wages, by encouraging the stabilization of labor, was expected to end the system of circular migration and increase labor productivity in both sectors. The commission's recommendation led to the introduction of an effective minimum wage in Tanganyika in 1957. Although this minimum was not confined to the public sector, evasion of the regulation was common in the private sector. Moreover, to set an example, the colonial government and, subsequently, the government of independent Tanzania tended to pay unskilled public sector employees a wage above the legislated minimum.

At the top of the pay scale Africanization of the civil service contributed to the observed sectoral segmentation of the market for wage labor. During the colonial period most high-level posts were held by Europeans, who received incomes twenty to thirty times those of African manual workers. These high incomes were primarily determined by alternative opportunities in the rich metropolitan countries rather than by opportunities in the colonial dependency. In 1961 only 26 percent of middle- and senior-level civil service posts were held by Tanzanians. By 1971 the proportion had increased to 85 percent. Since the number of posts had doubled over the period, this implied a sevenfold increase in the number of Tanzanians in high-level government positions. The public sector wage and salary structures did not fully adjust to reflect the decline in the supply price of the holders of these positions. To do away with what many people regarded as the fruits of independence and to introduce a large wage gap between Tanzanians and their expatriate counterparts would have been politically untenable. The wage structure in the private sector (except for the large multinationals that followed the public sector lead and, after nationalization, were incorporated into that sector) was more responsive to the change in labor market conditions.

Tanzania's pay equalization policy dates from the Arusha Declaration of 1967, which set Tanzania on a more egalitarian and socialist path. The basic problem posed by the country's inadequate educational inheritance was clearly stated by President Nyerere at that time: "The wage differentials in Tanzania are now out of proportion to any conceivable concept of human equality . . . yet we cannot at present greatly reduce this gap because of our shortage of skilled and qualified people" (Nyerere 1967b, pp. 16–17). The government adopted two approaches to resolve this conflict between the claims of equity and the reward that education could command in the market. One approach was to discourage elitist attitudes on the part of the educated. This was attempted through, for instance, exhortation and a system of national service under which young people, on completing upper secondary and tertiary education, served the community at low pay for eighteen months (Coulson 1982, pp. 181–82). The other approach was to introduce an egalitarian government pay policy.

The policy of wage compression extended beyond government employment to other parts of the public sector. After the Arusha Declaration parastatal organizations burgeoned owing to the nationalization or partial nationalization of large foreign companies. The Standing Committee on Parastatal Organisations (SCOPO) was established in 1967 to apply the government pay policy to the parastatals. In 1968 the committee issued a directive that prescribed common basic scales for parastatal employees, although incumbents were permitted to retain their existing pay levels. SCOPO undoubtedly had teeth. It laid down wage and salary scales for each occupation with the intention of keeping parastatal pay in line with government pay. At the time of the 1971 survey average wages in government and parastatal employment were on a par; the slight advantage of parastatal employees would have been larger had it not been for differences in mean characteristics (table 7-2). In neither sector had the new policy of compressing wages yet been forcefully implemented. The passage of time and the emergence of inflation in the 1970s, however, meant that the full effects of the policy would be observable in 1980.

In principle the egalitarian pay policy applied also in the private sector. There the enforcement agency was the Permanent Labour Tribunal (PLT), which had the power to vet and alter all collective bargaining agreements in pursuance of government pay policy but which in practice concentrated on regulating maximum increases in nominal pay. The government accounted for 24 percent of employees in the Dar es Salaam wage labor market and the parastatals for 38 percent (table 7-3). The private sector tail was therefore unlikely to be able to wag the public sector dog; that is, the public sector was large enough to pursue an independent pay policy for many occupations without fear of losing workers to the private sector. We hypothesize, therefore, that in 1980 pay in the public sector was less dispersed and was lower for the better paid than in the private sector.

Government policy on wages in the period immediately after independence in Kenya resembled that in Tanzania. The economic and political factors that influenced the wage leadership shown by the Kenyan government—the desirability of ending the system of short-term circular migration between the countryside and the towns and the need to provide tangible evidence of the fruits of independence—were much the same as in Tanzania.

Table 7-3. *Distribution of Employees, by Ownership Category and Educational Level, 1980*
(percent)

Item	*Private* (J_1)	*Government* (J_2)	*Parastatal* (J_3)
Kenya			
Manufacturing	92.6	0	7.4
Wage sector	60.6	21.6	17.8
E_1	88.7	7.5	3.8
E_2	74.2	5.6	20.2
E_3	64.1	14.5	21.4
E_4	52.9	29.2	17.9
E_5	54.6	34.4	11.0
Tanzania			
Manufacturing	45.9	0	54.1
Wage sector	39.0	23.5	37.5
E_1	49.2	9.9	40.9
E_2	53.9	10.3	35.8
E_3	45.0	21.9	33.1
E_4	28.2	32.5	39.3
E_5	15.8	35.2	49.0

Note: E_1, no education; E_2, primary standards 1–4; E_3, primary standards 5–7; E_4, forms 1–4; E_5, post–form 4.

Since the mid-1960s the Kenyan government has progressively drawn back from acting as a wage leader. Indeed, there is evidence that at some levels of pay the public sector has paid less than the private sector. Econometric evidence from an urban survey conducted in 1968 suggests that employment in the public sector lowered the earnings of the less educated and raised those of the more educated (Thias and Carnoy 1972). The table below (from Thias and Carnoy 1972, tables 3.8, 3.10, and 3.11) shows the coefficient on the public sector dummy variable in regressions stratified by years of education. The dependent variable is monthly earnings in shillings. The superscript * indicates significance at the 5 percent level.

	Years of schooling						
	0–2	*3–5*	*7*	*9*	*11*	*13*	*17*
Coefficient	-238^*	-210^*	36	145	793^*	1,113	8,096

The coefficient rises monotonically with years of education. It is initially negative but is positive for those who have at least completed primary education. No great reliance, however, can be placed on these findings, since the sampling procedure for the public sector was unsatisfactory, the authors were not directly concerned with the ownership category, and the equations contained variables that could be correlated with ownership category, such as firm size and sector of activity. A survey of high- and middle-level manpower in 1972 found that in all but one of fifteen narrowly defined occupations, average cash earnings were lower in the public than in the private sector (Collier and Lal 1986, table 12.5).

In recent years the Kenyan government, like the Tanzanian, has expressed itself in favor of equalizing wages. The Industrial Court is required to vet all collective bargaining agreements and to register only those conforming to government guidelines that seek to restrain nominal wage increases and compress the wage structure. According to the development plan document in force at the time of our 1980 survey,

> Lower-paid workers will continue to receive a relatively higher compensation for changes in the cost of living compared with higher-paid workers as a means of narrowing wage differentials. These guidelines will be applied to wages in the public as well as the private sector. (Kenya, Ministry of Economic Planning 1979, p. 41.)

There is reason to question whether in 1980 this policy in fact led to any significant departure from a market outcome for wage structure in either the public or the private sector. Unlike Tanzania, Kenya does not control pay in the public corporations, and the central government accounts for only 22 percent of our weighted sample of employees in Nairobi (table 7-3). Market competition from the private sector is therefore likely to have been felt more keenly than in Tanzania. Our interviews suggested that by 1980 the Kenyan government had adopted the prevailing wage rate approach to public sector wage determination; that is, public sector pay policy compressed the wage structure no more than would the market interaction of supply and demand. This might reflect either a lesser concern with the distribution of income than in Tanzania or an awareness that the rapid increase in the relative supply of educated labor would itself achieve the distributional goal. Our hypothesis for 1980, therefore, is that government pay policy has less influence in Kenya than in Tanzania and that pay in the Kenyan public service and public corporations differs little from pay in the private sector.

The Wage Distortion Hypothesis: Empirical Specification

We wish to test the hypothesis that pay policy has compressed the educational structure of wages, and thus caused an upward bias in the estimate of η_{sp}, in Tanzania but not in Kenya. We will simulate the wage structure in the absence of pay policy to estimate the shadow premium on secondary education and so obtain a measure of η_{sp} that is not distorted by pay policy.

The estimates of the simple earnings functions presented in table 7-1 suggest that the wage distortion hypothesis is correct. Since a far higher proportion of workers is employed in private firms in the manufacturing sector than in other sectors, a government policy that restrains public sector pay could explain why in Tanzania the premium on secondary education is higher in the manufacturing sector than in the wage sector as a whole. It could also explain why, when Kenya and Tanzania are compared, the relationship between relative supply and the premium is "well behaved" in manufacturing but not in the wage sector. We can test the hypothesis more rigorously by changing the specification of our earnings functions from

$$W = f(E_i, \mathbf{X}) \tag{7-4}$$

to

$$W = f(E_i, J_i, E_i \cdot J_i, \mathbf{X}) \tag{7-5}$$

where

W = log of individual earnings
E_i = a set of five dummy variables that signify levels of educational attainment, with standards 5–7 (E_3) as the base category
$\mathbf{X}$ = a vector of variables that measure other personal characteristics that influence earnings
J_i = a set of dummy variables that signify the ownership category of the firm by which the respondent is employed. The private sector (J_1) is the base category.

The coefficients on the dummy variables government (J_2) and parastatal (J_3) show the effect on earnings of employment in the nonmarket rather than the market sector. We refer to the public sector as the nonmarket sector and to the private sector as the market sector because the latter is likely to diverge less from free market conditions. (Whether and how private sector pay diverges from the free market outcome depends on the employment objectives of the government and on the degree of intersectoral mobility; see chapter 13.) The interaction terms ($E_i \cdot J_i$) permit the effect of ownership category to vary according to the level of education, thus testing the hypothesis that the pay policy is egalitarian.

In the simple earnings function based on equation 7-4, the premium on secondary education can be derived directly as e_4, the coefficient on E_4. In the function based on equation 7-5, however, there are additional components. The premium can be decomposed into (a) the component attributable to the difference between primary and secondary leavers in access to high-paying ownership categories and (b) the component attributable to the premium earned by secondary leavers within ownership categories.

Our method of estimating the effect of differences in the two educational distributions among ownership categories is to multiply c_i, the coefficient of J_i, by the proportion of workers (p_{ii}) in the relevant ownership category:

$$\sum_i c_i p_{4i} - \sum_i c_i p_{3i} = \sum_i c_i (p_{4i} - p_{3i}) \tag{7-6}$$

A similar adjustment is made for the $J_i \cdot E_j$ interaction terms, where d_{ii} are the relevant coefficients:

$$\sum_i d_{4i} p_{4i} - \sum_i d_{3i} p_{3i} = \sum_i d_{4i} p_{4i} \tag{7-7}$$

because the d_{3i} coefficients are zero. The full premium on secondary education is therefore:

$$\underset{\text{(from equation 7-4)}}{\pi = e_4} \quad = \quad \underset{\text{(from equation 7-5)}}{e_4 + \sum_i c_i (p_{4i} - p_{3i}) + \sum_i d_{4i} p_{4i}} \tag{7-8}$$

Since the private sector is the base subcategory in the dummy variable analysis, the influence of pay policy on the premium can be eliminated simply by setting the coefficients on J_i and $J_i \cdot E_j$ equal to zero in the right hand side of equation 7-8. The resulting change in the premium (from $Y_{T'}$ to $Y_{T''}$ in figure 7-2) provides a test of the hypothesis that the premium in Tanzania has been depressed by government intervention on pay. The simulation yields an estimate of the premium (point *d* in figure 7-2) that would prevail if market forces were permitted to operate freely but supply were unchanged. It is possible that the estimate will be biased because of the effect of the pay policy on the demand for labor in the nonmarket sector and on the supply of labor in the market sector, but the direction of bias cannot be predicted a priori (see chapter 13).

The Structure of Wages in the Market and Nonmarket Sectors: Testing the Hypothesis

Table 7-4 presents estimates of earnings functions for the full samples, excluding and then including the ownership and ownership-education interaction terms. In the simpler equations the results are generally as expected. Earnings increase monotonically with educational level in both countries and, with primary standards 5–7 (E_3) as the omitted category, all coefficients are significantly different from zero. The employment experience terms are highly significant and generate the expected inverted-U-shaped earnings-experience profile. Formal training and non-African race raise earnings, as do regular employment status in Kenya and male

Table 7-4. *Earnings Functions, Excluding and Including Terms to Capture the Effects of Pay Policy, 1980*

	Kenya		*Tanzania*	
Item	*Excluding pay policy*	*Including pay policy*	*Excluding pay policy*	*Including pay policy*
E_1	−0.358**	−0.351**	−0.285**	−0.336**
E_2	−0.199**	−0.224**	−0.220**	−0.211**
E_4	0.476**	0.485**	0.379**	0.761**
E_5	1.227**	1.385**	0.779**	1.218**
L	0.071**	0.070**	0.064**	0.057**
L^2	−0.001**	−0.001**	−0.001**	−0.001**
S_1	−0.023	−0.022	0.288**	0.254**
V_1	0.248**	0.250**	0.090**	0.144**
R_2	0.152*	0.119	−0.058	−0.118*
T_1	0.589**	0.565**	0.503**	0.323**
Government ownership (J_2)	—	0.235**	—	−0.140*
$J_2 \cdot E_1$	—	−0.172	—	0.090
$J_2 \cdot E_2$	—	−0.040	—	−0.049
$J_2 \cdot E_4$	—	−0.258**	—	−0.527**
$J_2 \cdot E_5$	—	−0.450**	—	−0.404**
Parastatal (J_3)	—	0.002	—	0.262**
$J_3 \cdot E_1$	—	0.680*	—	0.049
$J_3 \cdot E_2$	—	0.251	—	−0.025
$J_3 \cdot E_4$	—	0.183	—	−0.517**
$J_3 \cdot E_5$	—	−0.156	—	−0.630**
Constant	5.824	5.826	5.818	5.877
Mean of ln earnings ($\overline{Z}$)	6.885	6.887	6.684	6.684
$\bar{R}^2$	0.422	0.430	0.384	0.458
SE	0.614	0.610	0.533	0.501
F	118.4	61.44	100.4	67.40
N	1,610	1,606	1,598	1,575

— Not applicable.

* Significant at the 5 percent level.

**Significant at the 10 percent level.

Note: L, employment experience; S_1, male sex; V_1, formal training; R_2, regular employment; T_1, non-African. For definitions of education variables, see note to table 7-3.

sex in Tanzania. Roughly 40 percent of the variance in ln earnings can be explained in both countries.

The introduction of the terms intended to capture the effects of pay policy has little effect on the coefficients other than those on the education terms in Tanzania. The education coefficients still imply that earnings rise monotonically with education, but they now represent that relationship in the market sector, the private sector (J_1) being the omitted ownership category. The addition of the J_i and $J_i \cdot E_j$ terms as a group is significant at the 1 percent level in Tanzania but not in Kenya. In Tanzania the coefficients indicate that employment by government reduces earnings and that the educational structure of government and parastatal pay is more equal than that of private sector pay. The coefficients on all four postprimary education–public sector ownership interaction terms (with $J_1 \cdot E_3$ as the base subcategory) are significantly negative.

Figure 7-3 shows the structure of wages for primary and secondary leavers in the private sector and the public (government and parastatal) sector. The educational premiums (the standardized differences between ln earnings of E_3 and E_4 workers, as indicated by the slopes of the joining lines) were derived from the estimated equation as follows. Where e_j are the coefficients on E_j, c_i on J_i, and d_{ij} on $J_i \cdot E_j$, the premium on E_4 (forms 1–4) in relation to E_3 (standards 5–7, the base subcategory) is

$$\pi = e_4 \tag{7-9}$$

in the market sector and

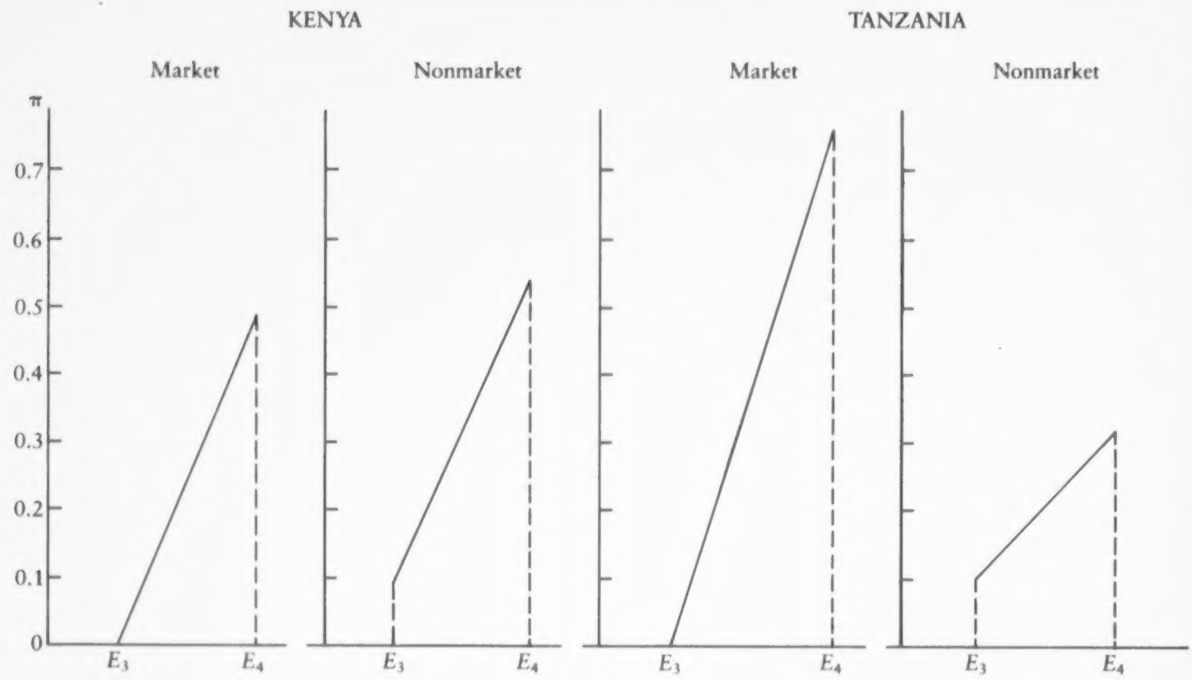
$$\pi = e_4 + d_{4i} \tag{7-10}$$

in the nonmarket sector. On the vertical axis ln earnings of E_3 workers in the market sector are set equal to zero in each country. The relationship between the standardized ln earnings of primary leavers in the nonmarket sector and those in the market sector is thus shown as the height of the E_3 observation in the nonmarket panels and is given by the value of c_i. Both the height and the slope of the line for the nonmarket sector are calculated as weighted combinations of the government and parastatal estimates. The weights are determined by the relative importance of government and parastatal employment for primary and for secondary leavers.

As figure 7-3 shows, the premium is large in the Tanzanian market sector and is much lower in the nonmarket sector. The pay policy in Tanzania operates against those with secondary education. It is notable that such large sectoral wage differences can persist in the market. They are likely to reflect the low labor turnover observed in our surveys and possible lags in the market adjustment process. In Kenya the $E_j \cdot J_i$ interaction terms display no coherent pattern, and most are insignificant. The premium on secondary education is similar in the market and nonmarket sectors. In sharp contrast to Tanzania, pay policy has not compressed the educational structure of wages.

With the use of the earnings function that contains the pay policy variables, the premium on secondary education can be built up to correspond to the premium derived directly from the earnings function without the

Figure 7-3. *The Premium to Secondary Education in the Market and Nonmarket Sectors, Kenya and Tanzania*



pay policy variables. The built-up premiums are 0.477 in Kenya and 0.385 in Tanzania, and the directly estimated premiums are 0.476 and 0.379, respectively. This result verifies equation 7-8. In Kenya eliminating the effect of pay policy (−0.009) increases the premium on secondary education by a negligible 2 percent. In Tanzania the increase is much more substantial; eliminating the effect of pay policy (−0.382) doubles the premium. The wage distortion hypothesis is confirmed: when the effect of pay policy is eliminated, the premiums are well behaved. The premium in Tanzania (0.761) exceeds that in Kenya (0.485) by 0.276.

Conclusions

In Tanzania, where the scarcity of secondary leavers places a high market premium on their services, the government has intervened to prevent scarcity rents from accruing to the educated. Despite having to work against the market, the policy is effective in the public sector, which is dominant in Tanzania; government intervention halves the average premium on education. A side effect of this intervention is that private sector employees with relatively high levels of education earn considerably more than their public sector counterparts. Such segmentation of the labor market by sector of ownership is not without its drawbacks, however—it may well produce new inequities and misallocation of labor.

No such intervention was observed in the Kenyan labor market. Our econometric results were consistent with a prevailing wage rate approach to public sector pay determination. It is possible that the Kenyan government chose to follow market forces because the rapid expansion of secondary enrollments in Kenya could be relied on to reduce the premium on secondary education. It is to the measurement of this relationship that we turn in chapter 8.

Notes

1. The terms relative wage (Y) and premium

$$\pi = \frac{w_s - w_p}{w_p} = Y - 1 = \ln w_s - \ln w_p$$

can normally be used interchangeably in the argument.

2. See, for instance, Bowles (1969, 1970), Dougherty (1972), Fallon and Layard (1975), the survey by Hammermesh and Grant (1979), and Psacharopoulos and Hinchliffe (1972).

3. Normally it is not possible to standardize the characteristics, such as employment experience, that are known to influence earnings, and the mean earnings of the two educational groups are used (see Bowles 1969, pp. 42–50). Pro-

duction function techniques have also been employed, however (see Dougherty 1972).

4. For example, the employment experience of secondary leavers could be greater in relation to that of primary leavers in Kenya, so that standardization for experience could reduce the Kenyan premium below the Tanzanian premium. In fact the reverse is the case, which explains why the Kenyan premium rises in relation to the Tanzanian when we substitute standardized for actual mean wages.

CHAPTER 8

Educational Expansion, Relative Demand, and Wage Compression

OUR OBJECTIVE IN THIS CHAPTER is to measure the responsiveness of the wages of secondary and primary leavers to changes in their relative supply (η_{sp}). Since chapter 7 confirmed the wage distortion hypothesis, we will need to allow for the effect of government pay policy on the premium to secondary education in Tanzania. We also have to take account of differences in relative demand that could bias our estimate of η_{sp}. Our first task, therefore, is to determine whether, despite the relative scarcity of secondary leavers in Tanzania, the premium on secondary education is lower there because, for any given level of supply in the relevant range, relative demand is greater in Kenya than in Tanzania. In other words, is the skill intensity of production greater in Kenya—for example, because of differences in sectoral composition or technology?

The Relative Demand Curve Hypothesis: Empirical Specification

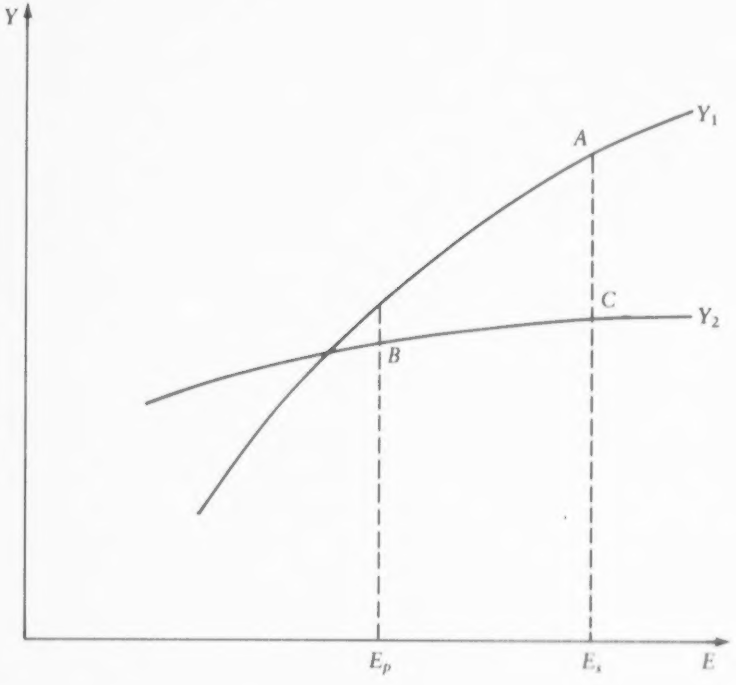
We wish to test the hypothesis that the relative demand for secondary leavers is greater in Kenya than in Tanzania and that the estimate of η_{sp} is therefore biased upward. If Kenya's relative demand curve lies above Tanzania's ($D_K > D_T$ in figure 7-2, above), we would expect that for any given relative supply (say, S_T) the premium is greater in Kenya ($\widehat{Y}_K > Y_T$). Since relative supply is actually much greater in Kenya than in Tanzania, to test the hypothesis we simulate a reduction of relative supply in Kenya to Tanzania's level and predict the Kenyan premium that would

Note: Adapted from J. B. Knight and R. H. Sabot, "Educational Expansion, Government Policy and Wage Compression," *Journal of Development Economics* 26, no. 2 (August 1987), pp. 201–21.

result. We refer to this predicted premium as $\widehat{Y}_K$. Alternatively, we simulate an increase of relative supply in Tanzania to Kenya's level and predict the Tanzanian premium that would result. The test lies in the comparison of the predicted premium of one country with the actual premium of the other. In figure 7-2, for instance, if relative supply in Tanzania is S_T, then Y_T (denoted by point *e*) should be compared with $\widehat{Y}_K$ (denoted by *g*). If the predicted and actual premiums are the same, we cannot reject the null hypothesis that Kenya and Tanzania have the same relative demand curve.

To explain the method that is employed to simulate a change in the relative supply of secondary leavers, it is helpful to consider the mechanisms by which the premium declines in response to relative educational expansion. Underlying the empirical analysis below is the notion of the occupational production function, already used in chapter 6 and expounded in appendix F. Two occupational production functions, Y_1 and Y_2, are illustrated in figure 8-1. *Y* represents productivity and *E* years of education; inputs of other factors are held constant. E_p and E_s represent

Figure 8-1. *Occupational Production Functions*



the completion of primary and secondary education, respectively. The slopes of the functions Y_1 and Y_2 between E_p and E_s indicate the additional productivity associated with secondary education in occupations 1 and 2.

As secondary education expands in relation to primary education, the wage premium on secondary education falls in an economy with competitive labor markets, partly because wage reductions in the occupations containing secondary leavers depress those occupational production functions. A limit to such wage reductions is imposed by the wages in occupations that employ primary leavers and by the need to compensate for differential acquisition of occupational skills. The premium is also reduced, however, by the movement of people with secondary education into less well-paid occupations—that is, by filtering down.

If there is occupational wage stickiness owing to occupation-specific human capital, institutional constraints, or adjustment lags, the occupational production functions will not move downward with the expansion of secondary education. Nevertheless, filtering down does occur and can compress the educational wage structure on its own. For instance, in figure 8-1 the wage of secondary leavers in occupation 1 remains at *A*, but those who filter down to occupation 2 receive wage *C*. As the (now fewer) primary leavers continue to receive wage *B* but secondary leavers receive a weighted average of *A* and *C*, the premium declines. In practice, the precise nature of filtering down depends on the degree of job security—that is, on whether less educated incumbents are displaced.

Educational expansion does not necessarily lead to greater compression of the wage structure when occupational wages fall than when they do not. This is because the occupational wage reductions tend to be offset by the expansion of employment in these occupations. No such absorption of secondary leavers can occur where wages are sticky, and the process of filtering down into less well-paid occupations therefore goes further.

The relative demand curve for workers with secondary education is influenced by occupational structure and by the positions and slopes of occupational production functions. For a given relative supply, with occupational production functions stable, the premium on secondary education is derived from the weighted averages of the (standardized) occupational wages of primary and secondary leavers; the respective weights are the proportions of primary and secondary leavers in each occupation. The relative movement of secondary leavers into jobs for which the wage is lower depresses the premium, as does their movement into jobs within which the premium is lower.

The first step in simulating a change in the relative supply of secondary leavers and the consequent decline in their premium is to decompose the premium on secondary education in our simple earnings function (the coefficient e_4 on E_4 in equation 7-4) into the component attributable to the difference between primary and secondary leavers in access to relatively high-paying occupations and the component attributable to the premium earned by secondary leavers within occupations. To effect such a decomposition we change the specification of our earnings function from equation 7-4 to:

$$W = f(E_j, O_k, E_j \cdot O_k, \mathbf{X}) \tag{8-1}$$

where O_k is a set of five occupational dummy variables, with O_3, skilled manual, as the base subcategory. The coefficients of the occupation variables represent the influence on earnings, after educational level is standardized, of being in one occupation rather than another. In effect, they show the relative positions of different occupational production functions. The interaction terms $(E_j \cdot O_k)$ permit the influence of education to vary according to occupation and, in effect, show the shapes of the different occupational production functions.[1] The occupation and interaction terms together permit the estimation of log linear approximations of occupational production functions such as those illustrated in figure 8-1 in the range between E_p and E_s.

As explained in chapter 6 and appendix E, particular care was taken in classifying workers into occupations on the basis of ascending order of expected skill—unskilled, semiskilled, and skilled for the manual occupations and lower clerical, higher clerical, and supervisory for the nonmanual occupations—and precisely the same criteria were applied in each country. For the reasons given in chapter 6 and appendix F, it is likely that observed differences in occupational production functions will represent differences in the value of cognitive and vocational skill acquisition for the different occupations.

The premium on E_4 in equation 7-4 can be decomposed with the use of equation 8-1 in a manner precisely analogous to the decomposition based on equation 7-8:

$$\underset{\text{(from equation 7-4)}}{\pi = e_4} \quad = \quad \underset{\text{(from equation 8-1)}}{e_4 + \sum_k a_k(p_{4k} - p_{3k}) + \sum_k b_{4k}p_{4k}} \tag{8-2}$$

where

a_k = the coefficients on the O_k terms
b_{jk} = the coefficients on the $E_j \cdot O_k$ terms
p_{jk} = the proportion of workers at educational level j in occupation k

The second step in simulating a change in relative supply involves changing the distributions of primary and secondary leavers across occupations. The effect in Tanzania of Kenya's greater relative supply can be simulated by imposing the education-occupation matrix of Kenya on Tanzania. We shall therefore assume that the occupational distributions of primary and secondary leavers in Tanzania respectively equal those of primary and secondary leavers in Kenya. Similarly, simulating Tanzania's lesser relative supply in Kenya is a matter of substituting in equation 8-2 estimated for Kenya the education-occupation matrix for Tanzania. Where p'_{jk} represents occupational composition in the other country, the simulated premium is calculated from the estimated equation 8-2 as:

$$\hat{\pi} = e_4 + \sum_k a_k(p'_{4k} - p'_{3k}) + \sum_k b_{4k}p'_{4k} \tag{8-3}$$

The simulated premiums obtained in this way, $\hat{\pi}_K$ and $\hat{\pi}_T$, are then compared with the actual premiums, π_K and π_T, to test the hypothesis that relative demand is greater in Kenya than in Tanzania. The empirical justification for our assumptions that the education-occupation matrix of one country is indicative of the education-occupation matrix in the other and that educational expansion does not change the occupational production functions will be provided below.

Occupational Production Functions in the Market and Nonmarket Sectors

The wage distortion hypothesis having been confirmed, we go on to test the relative demand hypothesis. We control for differences in pay policy between Kenya and Tanzania by incorporating the specification changes of equation 7-5 and equation 8-1. The estimated equation is thus:

$$W = f(E_j, J_i, E_j \cdot J_i, O_k, E_j \cdot O_k, \mathrm{X}) \tag{8-4}$$

The estimates of the regression equations in table 8-1 incorporate the ownership, occupation, and interaction terms. The education and occupation terms have the expected signs. In Tanzania all four education variables are significant, three of them at the 1 percent level; in Kenya three are significant at the 1 percent level. Four of the five occupation variables are significant at the 1 percent level for Tanzania, and for Kenya all five are significant at that level. Many of the education-occupation coefficients are large in relation to the corresponding E_j terms; although few are individually significant, their introduction as a group is significant at the 1 percent level in both countries. As was the case in table 7-5, which omitted the occupation terms, the ownership variables are significant at the 1 percent level for Tanzania but not for Kenya, and the education-ownership interaction terms are of the expected sign and are significant at the 1 percent level for Tanzania but not for Kenya.

As a consequence of adopting a specification that incorporates both hypotheses simultaneously, the full decomposition of the premium (combining equations 7-8 and 8-2) becomes:

$$\pi \, z \, e_4 + \sum_k a_k(p_{4k} - p_{3k}) + \sum_k b_{4k}p_{4k} + \sum_i c_i(p_{4i} - p_{3i}) + \sum_i d_{4i}p_{4i} \tag{8-5}$$

Table 8-1. *Results of the Complex Regression, 1980*

Item	*Coefficient*	E_1	E_2	E_4	E_5
Kenya					
E_1	0.272				
E_2	−0.272**				
E_4	0.239**				
E_5	0.808**				
J_2	0.017	−0.112	0.267	−0.199**	−0.237*
J_3	0.017	0.422	0.403**	0.097	0.043
O_1	0.516**	—	−0.639	0.419**	0.081
O_{2a}	0.694**	—	1.289**	0.023	−0.405
O_{2b}	0.249**	—	−0.415	0.088	−0.002
O_4	−0.203**	−0.238	0.154	−0.098	−0.800
O_5	−0.291**	0.294	0.162	−0.016	—
L	0.051**				
L^2	−0.001**				
V_1	0.157**				
R_2	−0.143**				
T_1	0.391**				
S_1	0.067				
$\bar{R}^2$	0.610				
SE	0.457				
F	62.22				
N	1,606				
Constant	6.246				
Mean of ln earnings ($\bar{W}$)	6.902				
Tanzania					
E_1	−0.224**				
E_2	−0.134*				
E_4	0.484**				
E_5	0.537**				
J_2	−0.208**	0.148	0.023	−0.295**	−0.322**
J_3	0.200**	0.182*	0.069	−0.361**	−0.522**
O_1	0.482**	—	—	−0.052	0.238
O_{2a}	0.494**	0.264	—	−0.173	−0.022
O_{2b}	−0.001	−0.058	0.046	−0.112	0.226
O_4	−0.332**	0.087	0.109	−0.118	−0.458
O_5	−0.367**	0.081	0.008	0.052	—
L	0.041**				
L^2	−0.001**				
V_1	0.041				
R_2	0.044				
T_1	0.165**				
S_1	0.206**				
$\bar{R}^2$	0.678				
SE	0.333				

Item	*Coefficient*	E_1	E_2	E_4	E_5
F	81.22				
N	1,563				
Constant	6.088				
Mean of ln earnings ($\bar{\bar{W}}$)	6.698				

— No coefficient could be estimated.

* Significant at the 5 percent level.

**Significant at the 10 percent level.

Note: E_1, no education; E_2, primary standards 1–4; E_4, secondary forms 1–4; E_5, post–form 4; J_2, government ownership; J_3, parastatal; O_1, supervisory; O_{2a}, senior clerical; O_{2b}, junior clerical; O_4, semiskilled manual; O_5, unskilled manual; L, employment experience; V_1, formal training; R_2, regular employment; T_1, non-African race; S_1, male sex. Interaction terms appear in matrix form. For instance, the coefficient on $J_2 \cdot E_1$ is 0.148 in Tanzania.

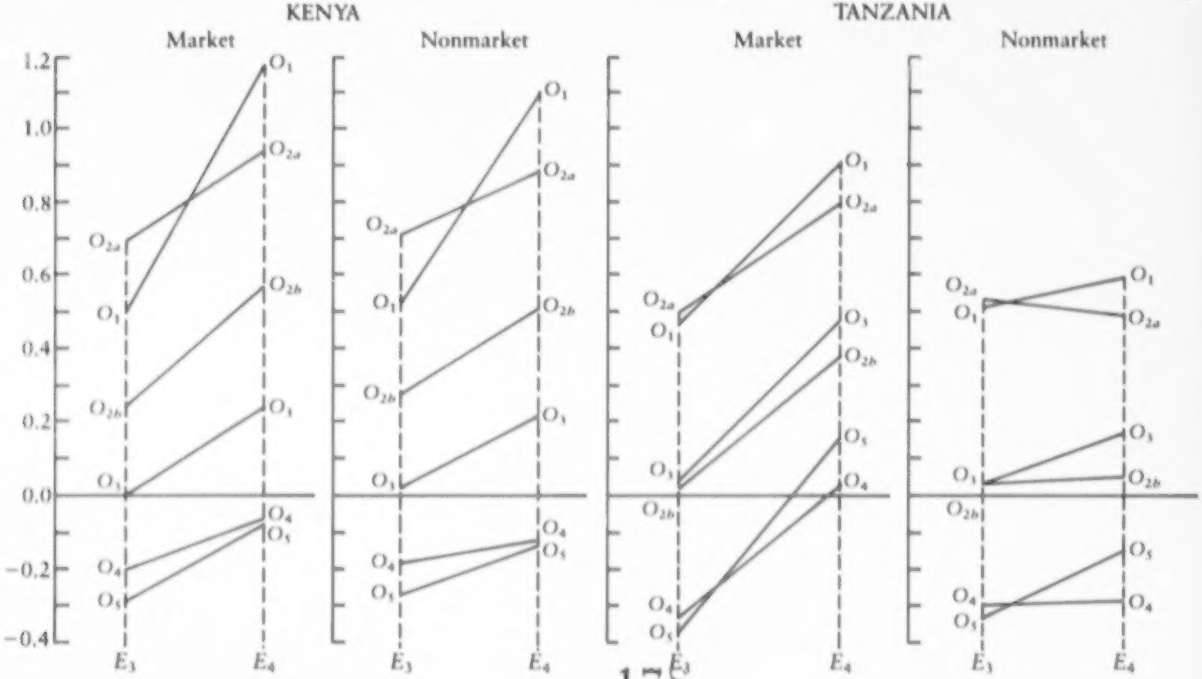
Whereas the premium estimated from the simple equation of table 7-1 is 0.472 in Kenya and 0.376 in Tanzania, that derived from the more complex equation of table 8-1 and built up according to equation 8-5 is 0.479 in Kenya and 0.393 in Tanzania. The close similarity of the results from the two methods confirms that the addition of occupation, ownership, and interaction terms has no appreciable effect on the premium, and our decomposition technique is thus validated.

In chapter 6 it was possible to decompose the premium on secondary education into the direct effect and the indirect effect that operates through occupational attainment. The predicted probabilities, derived from the multinomial logit analysis, were used to estimate the indirect effect. This estimate was almost precisely equal to that obtained from the use of the actual occupational distributions of primary and secondary leavers (chapter 6, note 12)—that is, the sum of the components almost precisely equaled the premium derived from the simple earnings function with occupation terms omitted. This result provides a justification for our present use of the actual occupational distributions of primary and secondary leavers rather than their occupational probabilities when other factors are held equal.

Figure 8-2 is an elaboration of figure 7-3 in that it adds occupation as a variable. It shows the occupational structure of wages for primary and secondary leavers in the private and public sectors—that is, the relevant segments of occupational production functions in the market and nonmarket sectors of each country. Where e_j are the coefficients on E_j, a_k on O_k, b_{jk} on $E_j \cdot O_k$, c_i on J_i, and d_{ij} on $J_i \cdot E_j$, the premium on E_4 (forms 1–4) in relation to E_3 (standard 7, the base subcategory), when occupation as well as ownership category is standardized, is

$$\pi = e_4 + b_{4k} + d_{4i} \qquad \text{(8-6)}$$

Figure 8-2. *The Premium to Secondary Education in the Market and Nonmarket Sectors, Kenya and Tanzania*



Given that J_1 (private) is the base ownership subcategory, the market sector premium is simply

$$\pi = e_4 + b_{4k} \tag{8-7}$$

In figure 8-2 ln earnings of E_3 workers in O_3 in the market sector in each country are set equal to zero on the vertical axis. For example, the line O_1O_1 for the Tanzanian market sector shows, by its height above E_3, the higher pay of a primary leaver in a supervisory than in a skilled manual occupation and, by its slope, the premium accruing to secondary education in the supervisory occupation. The occupational wages accruing to E_3 workers (shown by their height above E_3) are widely dispersed within a sector but are similar for the two sectors, whereas those accruing to E_4 workers differ greatly for the two sectors. In the market sector the premium is large and similar in each occupation, whereas in the nonmarket sector it is much lower. The pay policy in Tanzania operates against those with secondary education irrespective of occupation.

In Kenya the $E_i \cdot J_l$ interaction terms display no coherent pattern, and most are insignificant. Figure 8-2 shows that the slopes of the occupational production functions in Kenya are similar in the market and nonmarket sectors. In both sectors the premium on secondary education tends to increase with the hypothesized skill content of the occupation.

We can now calculate a shadow premium on secondary education in Tanzania. The influence of pay policy is eliminated by subtracting from the estimated premium the component attributable to pay policy (the last two terms of equation 8-5) to obtain the premium prevailing in the market sector. In Kenya eliminating the effect of pay policy (−0.031) increases the premium on secondary education by a negligible 6.5 percent. In Tanzania the increase is much more substantial; eliminating the effect of pay policy (−0.247) increases the premium on secondary education by two-thirds. The wage distortion hypothesis is confirmed: once the effect of pay policy is eliminated, the premiums are well behaved—the premium in Tanzania (0.640) is greater than that in Kenya (0.510) by 0.130.

Simulation of one country's relative supply of secondary leavers in the other country entails substituting in equation 8-5 the occupational distributions of primary and secondary leavers in one country for those in the other. It is apparent from a comparison of the market sectors of Kenya and Tanzania (figure 8-2) why this substitution changes the premium. The educational premium in Tanzania is larger at the three manual levels, similar at the two clerical levels, and smaller at the supervisory level, whereas in Kenya the premium is highest for the highest occupation and decreases as occupational level decreases. The country differences in occupational production functions within the market sector, however, are minor in comparison with the substantial differences among occupational production functions within each country. A change of occupation makes a big difference to one's earnings; the filtering down into lower-

Table 8-2. *Distribution of All Employees and of Primary and Secondary Completers by Occupation in the Manufacturing and Wage Sectors*

	Manufacturing									*Wage sector*					
	Tanzania 1971			*Tanzania 1980*			*Kenya 1980*			*Tanzania 1980*			*Kenya 1980*		
		Entered wage employment			*Entered wage employment*			*Entered wage employment*			*Entered wage employment*			*Entered wage employment*	
Item	*All employees*	*Up to 1963*	*1964–71*	*All employees*	*Up to 1972*	*1973–80*	*All employees*	*Up to 1972*	*1973–80*	*All employees*	*Up to 1972*	*1973–80*	*All employees*	*Up to 1972*	*1973–80*
All employees															
O_1	3.5	5.7	2.1	5.3	6.4	4.3	3.5	4.1	2.6	12.3	15.2	8.4	10.9	10.1	12.1
O_{2a}	—	—	—	4.2	4.5	4.2	1.5	1.4	1.6	4.8	5.5	4.2	7.1	11.3	2.5
O_{2b}	12.0	11.2	12.6	12.1	10.7	13.8	8.6	7.2	11.1	28.6	26.6	31.1	24.6	20.4	31.1
O_3	28.4	34.9	24.1	22.5	27.3	16.6	35.5	45.4	17.8	21.3	22.9	20.1	23.1	27.9	17.7
O_4	31.8	30.7	32.5	34.5	32.4	37.1	32.7	30.3	36.8	16.3	15.6	16.9	16.3	17.4	15.1
O_5	24.4	17.4	28.7	21.4	18.8	24.0	18.3	11.6	30.8	16.6	14.2	19.2	18.0	12.9	21.5
All nonmanual	15.5	16.9	14.7	21.6	21.6	22.3	13.6	12.7	15.3	45.7	47.3	43.7	42.6	41.8	45.7
Unskilled and semiskilled	56.2	48.1	61.2	55.9	51.2	61.1	51.0	41.9	67.6	32.9	29.8	36.1	34.3	30.3	36.6
Form 4 completers															
O_1	9.1	13.5	4.5	17.3	24.3	4.9	5.0	9.1	0.0	18.5	24.1	8.2	7.8	12.1	1.7
O_{2a}	—	—	—	12.5	16.8	4.9	3.3	5.5	0.7	13.1	13.6	11.7	12.6	19.9	2.0
O_{2b}	66.7	69.2	63.6	38.7	33.6	47.5	18.2	21.3	14.5	53.0	50.0	59.4	41.9	40.3	44.0
O_3	18.2	15.4	20.5	20.8	21.5	19.7	21.2	24.4	17.4	10.0	11.0	8.0	16.5	14.3	19.5
O_4	4.0	1.9	6.8	8.9	2.8	19.7	33.4	32.3	34.8	2.7	1.3	5.0	10.3	9.2	11.8
O_5	2.0	0.0	4.5	1.8	0.9	3.3	18.9	7.3	32.6	2.7	0.0	7.8	10.9	4.1	20.9

Table 8-2. *(continued)*

Item	*Manufacturing*									*Wage sector*					
	Tanzania 1971			*Tanzania 1980*			*Kenya 1980*			*Tanzania 1980*			*Kenya 1980*		
		Entered wage employment			*Entered wage employment*			*Entered wage employment*			*Entered wage employment*			*Entered wage employment*	
	All employees	*Up to 1963*	*1964–71*	*All employees*	*Up to 1972*	*1973–80*	*All employees*	*Up to 1972*	*1973–80*	*All employees*	*Up to 1972*	*1973–80*	*All employees*	*Up to 1972*	*1973–80*
All nonmanual	75.8	82.7	68.1	68.5	74.7	57.3	26.5	35.9	15.2	84.6	87.7	79.3	62.3	72.3	47.7
Unskilled and semiskilled	6.0	1.9	11.3	10.7	3.7	23.0	52.3	39.5	67.4	5.4	1.3	12.8	21.2	11.3	32.7
Standard 7 completers															
O_1	3.7	7.9	1.0	1.4	1.9	0.5	2.9	3.5	1.0	3.3	4.2	1.8	3.0	3.6	1.3
O_{2a}	—	—	—	2.0	0.2	0.5	0.2	0.3	0.0	1.1	1.4	0.5	3.4	4.5	0.0
O_{2b}	10.6	10.8	9.7	8.7	10.5	5.7	6.0	5.8	6.7	27.2	33.2	17.0	15.3	17.2	9.6
O_3	30.6	41.0	22.6	24.8	28.7	18.6	28.9	33.8	14.4	30.9	29.4	33.4	37.3	40.9	26.6
O_4	34.6	28.8	39.5	41.1	38.9	44.8	39.8	40.5	37.5	23.3	21.8	25.7	20.8	19.4	25.0
O_5	20.3	11.5	27.2	22.0	17.8	28.9	22.2	16.1	40.4	14.3	10.0	21.6	20.1	14.4	37.5
All nonmanual	14.3	18.7	10.7	12.1	14.6	7.7	9.1	9.6	7.7	31.6	38.8	19.3	21.7	25.3	10.9
Unskilled and semiskilled	54.9	40.3	66.7	63.1	56.7	73.7	62.0	56.6	77.9	37.6	31.8	47.3	40.9	33.8	62.5

— Not applicable.

Note: O_3, skilled manual. For definitions of other variables, see note to table 8-1.

paying occupations of secondary leavers in relation to primary leavers could have a substantial effect on the premium.

The Process of Filtering Down

The occupational attainment functions presented in chapter 6 showed that the probabilities of being in a particular occupation are greatly dependent on two factors: the education of the worker and the year of his entry into wage employment. We now examine the influence of these two factors on the occupational adjustments that result from the expansion of secondary education.

The distribution of employment by occupation is shown in table 8-2. Considerable similarity can be observed in the three manufacturing samples and between the two wage sector samples. The similarity in the distributions of employees by occupation and the marked difference in the distributions by education (table 7-1) imply that the education-occupation matrix is different for the two countries. As table 8-2 shows, in Tanzania's wage sector 53 percent of secondary leavers were in junior clerical occupations and only 15 percent were manual workers, whereas in Kenya 38 percent were manual workers.

More filtering down had occurred in manufacturing; the proportion in white-collar occupations fell slightly, from 76 to 69 percent, between 1971 and 1980 in Tanzania, and it was a low 27 percent in Kenya in 1980. The filtering down of secondary leavers into lower-level occupations had thus gone further in Kenya than in Tanzania. It is apparent from the table that the occupational distributions of primary leavers are less dissimilar in the two countries than those of secondary leavers; indeed, in the manufacturing sector their distributions are much the same. The rapid expansion of secondary education in Kenya has caused secondary leavers to filter down the occupational scale not only in absolute terms but also in relation to primary leavers.

Table 8-2 also suggests that the incidence of filtering down is cohort specific. A breakdown by years since entry into wage employment shows that the more recent cohorts did more of the filtering down into manual occupations. For instance, in Kenya 33 percent of secondary leavers who had entered the labor market in the previous seven years, but only 11 percent of those who had entered earlier, were in unskilled or semiskilled jobs; the corresponding figures for Tanzania were 13 and 1 percent. The difference between cohorts was even more marked in manufacturing—67 percent for the more recent cohort and 40 percent for the earlier cohort in Kenya and 23 and 4 percent in Tanzania. Tracing a cohort between 1971 and 1980 by means of the Tanzanian manufacturing samples shows that only a minor part of the cohort difference can be explained by occupational upward mobility with employment experience.

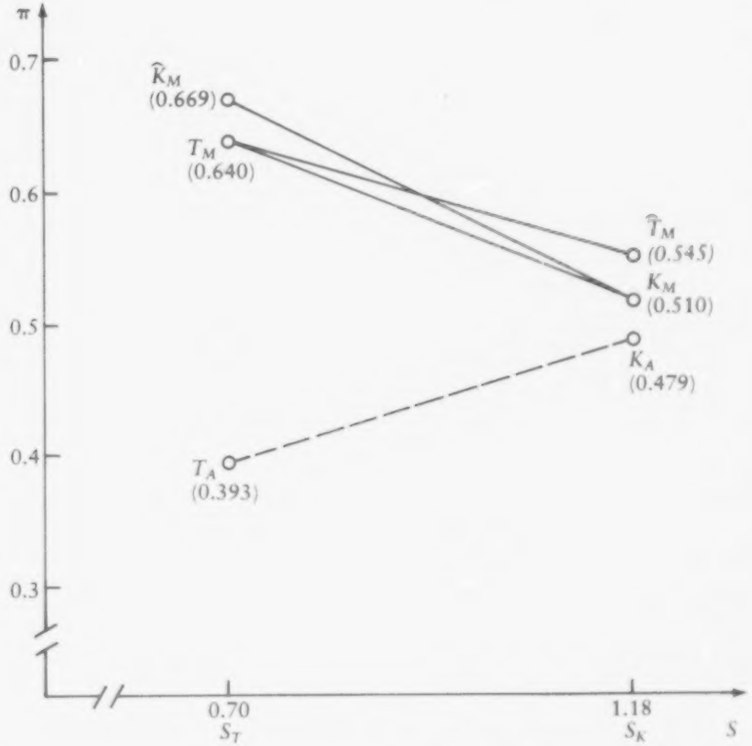
These cohort effects reflect the low rate of occupational mobility in both samples, which is the outcome of a related set of labor market phenomena. The surveys indicated remarkably low rates of labor turnover—a change of employer once in 9.3 years on average in Kenya and once in 16.8 years in Tanzania (the figures are the mean value of years of employment experience per quit). The combined result of legislation, trade union pressure, and the general ethos is that incumbents enjoy considerable job security. Vacancies tend to be filled on the basis of educational criteria; for many jobs the more educated applicants receive preference. As might be expected from the lack of educational provision in the past, many workers are considered undereducated for the jobs they perform. The rapid expansion of education also helps to explain why employers, when they make hiring decisions, consider the cohort differences in education more important than the cohort differences in employment experience. The preference-ordering of educational levels by employers—which corresponds to our occupational classification by skill level—produces the same predictable process of filtering down in both countries. It is for these reasons that we expect Kenya's education-occupation matrix to illustrate what Tanzania's matrix would be if Tanzania pursued the Kenyan educational policy, and the reverse.

An assumption that underlies the simulations is that the coefficients in the earnings function are invariant with respect to changes in the relative supply of secondary leavers. The presence of occupation-specific human capital, as documented in chapter 6, is an important reason for expecting resistance to the compression of the occupational wage structure with educational expansion. Educational expansion does not itself necessarily diminish the scarcity rents to be obtained from the possession of vocational skills. Even if workers effectively pay the entire cost of their training, profit-maximizing employers may protect trained incumbents against competition from untrained entrants to avoid disruption of production and to maintain worker morale. In addition, long lags in the adjustment of the occupational wage structure to changes in relative supply are not implausible given the importance of institutional wage-setting in Kenya and Tanzania (see, for instance, House and Rempel 1978, Jackson 1979, and Lindauer and Sabot 1983). Moreover, the low rates of labor turnover and the security of tenure generally enjoyed by incumbents suggest that competition in the wage labor market is unlikely to be strong except among entrants. We regard it as reasonable, therefore, to conduct the simulations on the assumption that occupational production functions are stable.

Testing the Relative Demand Hypothesis

We can now answer the following questions by reference to the market sector. What would be the premium in Tanzania if education had been expanded or were in the future expanded so that the relative supply of

Figure 8-3. *The Estimated Premium as a Function of Relative Labor Supply*



secondary leavers equaled that of Kenya? Or what if secondary education had been expanded in Kenya only as much as in Tanzania? The answers are depicted in figure 8-3, which is an estimated version of the model presented in figure 7-2. The values of S in Tanzania and Kenya, 0.70 and 1.18, respectively, are marked on the horizontal axis. The points T_A and K_A show the actual premiums estimated from the two samples, and T_M and K_M show the market sector premiums (net of pay policy). The points $\widehat{T}_M$ and $\widehat{K}_M$ indicate, respectively, the premiums predicted for Tanzania and Kenya under the assumption that the relative supply of the other country applies. When relative supply in Tanzania is raised to Kenya's level, the premium in Tanzania falls from 0.640 to 0.545, whereas the Kenyan premium is 0.510. The decrease of 0.095 is explained wholly by the reweighting of the occupation coefficients (−0.106). Similarly, when relative supply in Kenya is lowered to Tanzania's level, the Kenyan premium rises from 0.510 to 0.669, whereas the Tanzanian premium is 0.640. The increase of 0.159 is attributable mainly to the reweighting of the occupation coefficients (0.098) but also to the reweighting of the coefficients on the education-occupation terms (0.061), which reflects the higher premium on secondary education in the more skilled occupations in Kenya.

When both pay policy and the relative supply of secondary leavers are standardized, the two labor markets generate roughly the same premium: the difference between K_M and $\widehat{T}_M$ is 0.035 and that between T_M and $\widehat{K}_M$ is only 0.029. The "difference in relative demand curves" hypothesis is that, despite the relative scarcity of secondary leavers in Tanzania, the premium is lower there because relative demand is greater in Kenya. Given the similarity of the actual and predicted premiums, we cannot reject the null hypothesis that Kenya and Tanzania have the same relative demand curve. The policy differences between the two countries—Tanzania's policies on protection, trade controls, and foreign investment are more interventionist—have not created significant differences in the structures of their urban economies or in their use of foreign technology and therefore in their relative demand curves.

Estimating the Elasticity

Estimating η_{sp} (as in equation 7-1) on the basis of a comparison of T_A and K_A yields the anomaly of a positive elasticity that we have been attempting to explain. Eliminating the effect of pay policy and thereby raising the Tanzanian premium from T_A to T_M resolves the anomaly: whether the elasticity is estimated from the Kenyan or the Tanzanian equation or from K_M and T_M, it will be negative. Use of the Kenyan demand function (comparing K_M and $\widehat{K}_M$) yields $\eta_{sp} = -0.303$; use of the Tanzanian demand function (comparing T_M and $\widehat{T}_M$) yields $\eta_{sp} = -0.181$; and use of the market sector premiums (comparing K_M and T_M) yields $\eta_{sp} = -0.247$. These results are consistent with those for other studies, which—although they are sensitive to the choice of data and methods of estimation—generally yield numerical values of η well below unity.[2] Educational expansion has a similar effect on the structure of earnings, whichever demand function is used. A doubling of the ratio of employees with secondary education to those with primary education would compress the ratio of their earnings by about 25 percent. These values of η_{sp} imply a value of its reciprocal (σ_{sp}) well above unity and indeed greater than 3; that is, there is a fairly high degree of substitutability between educational levels.

The simulations have been conducted within the framework of stable occupational production functions. If, after expansion of secondary education, the occupational wage structure in Kenya is not in equilibrium, our results may be biased. We argued above, however, that the effect of wage stickiness on the premium could not be determined a priori: wage stickiness prevents factor substitution and so extends the filtering down process into less well-paid occupations. This, together with the evidence that through standardization we could reproduce in one country the premium of the other, suggests that the bias introduced by our inability to incorporate occupational wage flexibility in the simulations is only slight.

The simulation of the premium that would prevail in Tanzania were it to adopt the education policy of Kenya was carried out on the assumption that the Kenyan education-occupation matrix would then apply. This assumption is open to the criticism that the expansion of secondary education in Tanzania might be accompanied by development policies that would change significantly the composition of output and employment. What would be the effect of such structural change on the distribution of occupations and hence on the education-occupation matrix? What would be the consequent effect on the premium to secondary education and hence on the elasticity?

We examine the sensitivity of the premium to structural change by making two extreme assumptions about what Tanzania will do in addition to expanding secondary education to achieve the Kenyan ratio. The first assumption is that Tanzania adopts an ambitious industrialization policy; the second is that it instead adopts a policy of far-reaching "bureaucratization." The assumptions imply that instead of the actual sectoral distribution of wage employment (31 percent in manufacturing, 20 percent in public services, and 49 percent in other activities in Tanzania and a similar distribution in Kenya) the distributions become 45, 10, and 45 percent, respectively, under the industrialization policy and 15, 35, and 50 percent under bureaucratization. The effect of sectoral change on the occupational distribution is estimated by assuming that the occupational distributions within sectors remain fixed, and the effect on the education-occupation matrix is estimated by assuming that the occupational promotions and demotions of workers that are made necessary by the change in occupational composition are based strictly on their educational qualifications. The premium on secondary education in the market sector of Tanzania is then calculated as:

$$\pi_t = e_4 + \sum_k a_k(p''_{4k} - p''_{3k}) + \sum_k b_{4k}p''_{4k} \qquad (8\text{-}8)$$

where p''_{jk} is the Kenyan proportion of workers with education j in occupation k.

The industrialization drive decreases the share of nonmanual occupations in the total and increases the share of unskilled and semiskilled manual occupations. Bureaucratization has the opposite effects. The industrialization policy causes negligible filtering down of secondary leavers, but it depresses the proportion of primary leavers in nonmanual jobs by 5 percentage points and raises the proportion in the lesser jobs by 6 percentage points. It is for this reason that the premium on secondary education, which falls from 0.640 to 0.545 as a result of educational expansion alone, decreases only to 0.571 when the industrialization policy is added. The main effect of bureaucratization is to raise the proportion of secondary leavers in nonmanual jobs by 19 percentage points and to lower the proportion in lesser jobs by 17 points; primary leavers, by contrast, filter down. As a result the premium decreases only from 0.640 to 0.609 when bureaucratization accompanies educational expansion. The values of η_{sp} implied by these simulations are −0.13 with the industrialization policy and −0.06 with bureaucratization, instead of −0.18.

The illustrative assumptions chosen are so extreme as to be beyond the range of feasible policy options for Tanzania. Nevertheless, the simulations suggest that the extent of wage compression resulting from educational expansion can be a function of the accompanying development strategy. Although we have found no evidence that the relative demand curves of Kenya and Tanzania are different, it is possible that a country's relative demand curve will alter as development proceeds.

Conclusions

Because of their marked difference in the relative supply of workers with secondary education and their broad similarities in economic structure and level of development, suggesting similarity in relative demand, Kenya and Tanzania constitute a natural experiment. In this chapter we have made use of the natural experiment to address a number of central questions concerning education and labor market policies in developing countries.

First, the governments of both countries have expressed their desire to compress the widely dispersed wage structures that they inherited. Our estimate of η_{sp}, the elasticity of the response of relative wages to supplies of secondary in relation to primary leavers, confirmed that the expansion of postprimary education is a means of achieving that objective. Although the responsiveness is not high (η_{sp} being a third or less), the degree of compression achieved in Kenya has not been negligible. The premium on secondary education in the market sector is about 20 percent lower in Kenya than in Tanzania for this reason and is also no doubt significantly lower than in Kenya a decade ago.

The second question concerns the efficiency with which labor markets adjust to the rapid expansion of an education system. Because the wage sector is both relatively small and highly selective of the educated, educational expansion produced a sharp increase in the educational attainment of entrants into the wage sector. Rapid and extensive labor market adjustment was required, and lags in the adjustment process may have generated inefficiency. Particularly in Kenya, where expansion was more rapid, compression of the earnings structure might have gone further, and workers might have been more efficiently allocated to jobs, had the labor market been more competitive.

Third, the analysis throws light on the central relationship between education and productivity (which was more directly examined in part II) and on the economic criteria to be used in allocating resources to education. The low value of η_{sp} implies a high value (3 or more) for the elasticity of substitution between the two educational levels. This finding suggests that educational expansion produces only a gradual decline in the productivity gain to be derived from secondary education, and it thus supports the rate of return approach rather than the manpower requirements approach. The latter ignores the benefits, revealed in this study, from increasing the educational level within occupations. Nevertheless, the less than infinite elasticity—which reflects the filtering down of the educated into lesser jobs as education is expanded—implies that the rate of return, as conventionally estimated, can be a misleading guide in planning educational expansion. The shortfall of the social return below the private return, as implied by the occupation terms in the earnings function, and of the marginal return below the average return, as implied by cohort-specific filtering down, are examined in chapter 14.

It may not be possible to generalize from this particular natural experiment, involving as it does countries in which incomes and the education of the labor force are among the lowest in the world. But any extension of the comparative approach to other countries must avoid the pitfalls that our analysis has uncovered. In East Africa the conventional method of estimating the elasticity of substitution yields grossly biased estimates because of the distorting effect that government policy has on pay. Bias can also arise from differences in relative demand curves, although we found no evidence of this in Kenya and Tanzania. If elasticities are derived from comparisons of countries with greater differences in the structure and level of income, differences in relative demand are more likely to be a source of bias.

Notes

1. The base category is $E_3 \cdot O_3$ (standards 5–7 × skilled manual occupation).

2. Bowles (1969, ch. 3, and 1970) used cross-section analysis to estimate $\eta_{sp} = -0.08$. Psacharopoulos and Hinchliffe (1972), in an attempt to improve on Bowles, estimated $\eta_{sp} = -0.21$. Fallon and Layard (1975, pp. 288–89) derived a cross-country estimate of $\eta_{sp} = -0.28$ (although it was -1.63 when the less educated category was constrained to have the same elasticity with human as with physical capital). Dougherty (1972) used U.S. census data to obtain aggregated estimates of -0.05 to -0.30 for η_{sp} for various educational categories.

CHAPTER 9

Educational Expansion and the Kuznets Effect

ECONOMISTS AND ECONOMIC POLICYMAKERS show concern not only for economic efficiency but also for equity. They would generally agree that greater equality would be socially beneficial if it could be achieved without reducing efficiency. The diverse rationales for this belief include the concept of the diminishing marginal utility of income and the notion that the welfare of an individual depends on the income of others. There is disagreement, however, about how to weight marginal changes in these components of social welfare and how to measure the tradeoff between efficiency and equality. Another issue concerns the magnitude of inequality, which is generally measured by the dispersion of individual or household incomes.

In this chapter we examine the dispersion of the main component of the income of urban workers, wages from employment. So far in part III we have focused on the structure of wages—for example, on the average wage of one educational group compared with that of another. The dispersion of wages is a function both of the structure of wages and of the distribution of employees within that structure. Educational expansion can therefore have two effects on the inequality of pay. The narrowing of the wage structure, analyzed in chapters 7 and 8, is termed the compression effect. The changes in inequality brought about by changes in the educational composition of the labor force are referred to as the composition effect. Our natural experiment allows us to examine not only the dynamics of the wage structure but also the dynamics of wage dispersion associated with educational expansion.

The compression effect of educational expansion always works to reduce inequality; the composition effect may increase or decrease inequality. It is therefore possible for the two effects to work against each other, and the net outcome is then unclear. We wish to discover how the rapid

Note: Adapted from J. B. Knight and R. H. Sabot, "Educational Expansion and the Kuznets Effect," *American Economic Review* 73, no. 5 (December 1983), pp. 1132–36.

expansion of secondary education in Kenya and Tanzania alters the inequality of pay.

It is widely accepted that in the process of economic growth the inequality of income first increases and later decreases. This view was first propounded by Kuznets (1955) and was supported empirically by Ahluwalia (1976) and Ahluwalia, Carter, and Chenery (1979). It is also widely recognized that the inequality of pay is an important component of total income inequality; see, for instance, Blinder (1974) and Phelps Brown (1977). Whether the rapid expansion of education that has occurred in many countries has increased or decreased the inequality of pay—thereby delaying or hastening the arrival at the point beyond which economic growth is associated with a reduction of inequality—is relevant to policy.

This chapter uses a simulation methodology that is explained in general terms in appendix D. We are content here to introduce the underlying concepts, leaving their specific application for later in the analysis. We begin by estimating a relationship between earnings and its determinants. We then use those estimates to carry out simulations to examine the effect of each determinant on the dispersion of earnings.

We can, for instance, measure the relative contribution of each independent variable to inequality by assuming that each variable in turn has zero variance. In this case the counterfactual question being posed is, what would be the impact on inequality if the dispersion attributable to each determining characteristic were in turn eliminated? Or we can examine the effect on inequality of substituting in one sample some aspect of a second sample—one or more coefficients or one or more values or distributions of the explanatory variables. For instance, what would be the effect on inequality if, other factors being kept equal, the gross return to education in the second sample were applied to the first? What if the educational composition of the second sample were found in the first? By these means the effects of educational expansion can be simulated and decomposed.

Educational Expansion and Inequality of Pay in the Manufacturing Sector

By confining our analysis to the manufacturing sector, we can base it on three precisely comparable surveys of wage employees that were conducted in Tanzania in 1971 and 1980 and in Kenya in 1980. These samples can be thought of as three points in a time series. Tanzania 1971 has the smallest relative supply of educated workers; Kenya 1980, which has the highest relative supply, represents Tanzania some years hence. We measure the change in wage dispersion from one survey to another and estimate the relative contributions to that change of the composition and compression effects of educational expansion.

The change in the educational composition of the labor force itself has an effect on inequality. Whether it raises or lowers inequality, other things being equal, depends on the relative sizes, mean wages, and wage dispersions of the different educational categories. It can be shown that in a two-group model a transfer of workers from the low-education to the high-education (and high-wage) group raises the variance (or log variance) until the high-education group reaches a certain proportion of the total. The precise proportion depends on the differences in the means and the variances of the two groups. Robinson (1976, p. 438) has shown, for workers in the *j*th group, that where

$\bar{x}_j$ = mean earnings
p_j = proportion of workers
σ_j^2 = variance of earnings
j_1 = educated group
j_2 = uneducated group
σ^2 = variance of earnings in the population

then inequality (as measured by σ^2) rises to a maximum where p_1 is equal to p_1^*:

$$p_1^* = \frac{\sigma_1^2 - \sigma_2^2}{2(\bar{x}_1 - \bar{x}_2)} + \frac{1}{2} \tag{9-1}$$

This implies that $p_1^* \gtrless 1/2$ as $\sigma_1^2 \gtrless \sigma_2^2$. If the variance of wages of the educated group exceeds that of the uneducated ($\sigma_1^2 > \sigma_2^2$), inequality reaches a peak after more than half of the labor force has become educated. The condition $\sigma_1^2 > \sigma_2^2$ also implies that p_1^* is larger the smaller is the difference in mean wages; that is, inequality peaks later in the process of educational expansion the lower is the premium on education. If the variance is higher for the uneducated group, however, this result is reversed.

This was the basis of Kuznets's hypothesis: the transfer of people between sectors at different income levels initially increases inequality as more people acquire high income but eventually reduces it as fewer low-income people remain. If there is more inequality in the expanding sector, the peaking of aggregate inequality is delayed.

Kuznets concentrated on the composition effect and did not incorporate any resulting compression effect. Indeed, he suggested (Kuznets 1955, p. 8) that the urban-rural income differentials with which he was concerned were likely to increase with economic development. But because the competitive market prediction is that the returns to a factor decrease as its relative supply increases, we expect the coefficient on education in an earnings function to decline as education expands in relation to other factors. That is, the premium on education falls as supply increases in relation to demand. Other things being equal, the narrowing of the educational structure of wages should reduce inequality. This result can be formalized by differentiating the well-known identity

$$\sigma^2 = p_1\sigma_1^2 + (1-p_1)\,\sigma_2^2 + p_1(1-p_1)\,(\bar{x}_1-\bar{x}_2)^2 \tag{9-2}$$

to derive

$$\frac{\partial\sigma^2}{\partial p_1} = (\sigma_1^2-\sigma_2^2) + (1-2p_1)\,(\bar{x}_1-\bar{x}_2)^2 + 2p_1(1-p_1)\,(\bar{x}_1-\bar{x}_2)\left(\frac{\partial\bar{x}_1}{\partial p_1} - \frac{\partial\bar{x}_2}{\partial p_1}\right) \tag{9-3}$$

Since

$$\bar{x}_1>\bar{x}_2, \quad \frac{\partial\bar{x}_1}{\partial p_1} < 0 \quad \text{and} \quad \frac{\partial\bar{x}_2}{\partial p_1} > 0$$

the third term, which shows the effect of educational expansion on the wage structure, is negative. The effect of educational expansion on inequality is therefore the net outcome of two potentially countervailing tendencies, and no prediction can be made a priori about its sign.

Owing to the expansion of educational enrollments in Tanzania and the faster rate of expansion at the secondary level in Kenya, our three samples show sharp differences in the educational attainment of the labor force in the manufacturing sector (table 9-1). The differences are most marked at the secondary (forms 1–4) level. The occupational structure is similar in the three samples, and since our occupational classification is based on skills, the composition of demand for skills is also likely to be similar. The resulting differences in the education-occupation matrix

Table 9-1. *Educational Level of Employees in the Manufacturing Sector and Coefficients on the Education Dummy Variables in Simple Earnings Functions*

Educational level	*Tanzania 1971*		*Tanzania 1980*		*Kenya 1980*	
	Percent	*Coefficient*	*Percent*	*Coefficient*	*Percent*	*Coefficient*
E_1	24.4	−0.236	11.9	−0.254	5.1	−0.202
E_2	27.6	−0.150	18.6	−0.124	12.8	−0.176
E_3	36.2	0.000	48.7	0.000	46.3	0.000
E_4	10.2	0.748	16.6	0.502	33.3	0.256
E_5	1.6	1.199	4.2	0.968	2.6	0.932

Note: E_1, no education; E_2, primary standards 1–4; E_3, primary standards 5–7; E_4, forms 1–4; E_5, post–form 4. The distribution is the percentage of the column total. The base subcategory for the coefficients is primary standards 5–7; ln earnings is the dependent variable. All the coefficients are significantly different from zero at the 5 percent level.

are therefore likely to be attributable to differences in the relative supply of educated labor, which is lowest in Tanzania 1971 and highest in Kenya 1980.

An earnings function that includes the educational categories among the independent variables and log earnings as the dependent variable shows high and significant gross returns to education in all three samples (table 9-1).[1] The coefficients for postprimary education (with primary standards 5–7 as the base subcategory) are higher in Tanzania 1971 than in Tanzania 1980 and are higher in Tanzania 1980 than in Kenya 1980. Again, the differences are most marked at the secondary (forms 1–4) level. This compression of the educational structure of wages as a consequence of educational expansion is consistent with the competitive market prediction.

We proceed to measure the effect of educational expansion on the inequality of pay and the relative contributions of the compression effect and the composition effect. The method is an extension of that used by Blinder (1974) to decompose the inequality of an income distribution; it is discussed in appendix D. First, we estimate an earnings function

$$W = a + \sum_i e_i E_i + \sum_j c_j X_j + u \tag{9-4}$$

where

W = ln earnings
E_i = dummy variables that represent different educational categories
X_j = other independent variables
u = an error term
a, e_i, c_j = parameters

The estimated earnings function is used to predict the ln earnings of each individual worker ($\widehat{W}$) from his characteristics, and the inequality of predicted earnings is then measured.

Second, we simulate the compression effect of increasing the relative supply of educated labor. The wages of workers in each sample are predicted using the education coefficients estimated for the other samples instead of the actual coefficients. For instance, where the subscript K denotes the Kenya 1980 sample and the subscript T the Tanzania 1980 sample, we predict the wages of the Kenya sample using the Tanzanian education coefficients

$$\widehat{W}_K = a_K + \sum_i e_{iT} E_{iK} + \sum_j c_{jK} X_{jK} \tag{9-5}$$

Third, we simulate the composition effect of increasing relative supply. Instead of the actual educational composition of each sample we assume in turn the composition of the other samples. This involves reweighting the observations. For example, where α_{iK} represents the proportion of workers in each educational category E_i in the Kenya 1980 sample and α_{iT} the proportion in the Tanzania 1980 sample, in applying to the Kenya sample the Tanzania 1980 composition, we use the set of weights α_{iT}/α_{iK}. (The weighting procedure implies that the total number of observations is left unchanged.) In this case the simulation involves a decrease in the proportion of workers with secondary education and an increase in the proportion with primary education. The former observations are therefore given a weight of less than unity and the latter a weight of greater than unity in generating the assumed distribution.

Fourth, we combine the composition effect and its consequent compression effect in a single simulation. The inequality of the simulated wage distribution is measured in each case.

The index of inequality used throughout this chapter is the variance of ln earnings (that is, log variance). Other indexes that were calculated include the Gini coefficient, the Theil measure, the Atkinson measure, and the coefficient of variation of the wage. The pattern of results, however, is not sensitive to the choice of index, and the log variance is chosen as representative because of its use in the theory developed above.

The results of the first exercise, based on equation 9-4, indicate that the inequality of predicted wages is greatest in Tanzania 1971 and least in Kenya 1980: the log variances for the three samples are 0.230, 0.128, and 0.097. Inequality is less the greater the relative supply of educated labor. But to what extent are these differences attributable to the compression effect, to the composition effect, and to differences in the samples that are not related to education?

The results of the second exercise are shown in figure 9-1. The unsimulated but predicted log variances for the three samples are circled in each panel. A line connecting points in panel A indicates the effect on the log variance for one sample when the education coefficients are altered to those estimated for the other samples. The line marked *T71*, for instance, indicates the log variance when the education coefficients of the Tanzania 1971, Tanzania 1980, and Kenya 1980 samples are applied in turn to the Tanzania 1971 function. As expected, all lines in panel A slope downward; the decline in the premium on education, considered in isolation, consistently reduces inequality.

The connecting lines in panel B show the effect of altering the educational composition of a sample while the coefficients on education remain unchanged. The line labeled *T71*, for instance, shows how inequality varies as the educational compositions of the Tanzania 1980 and Kenya 1980 samples are applied to the Tanzania 1971 earnings function and sample. In all but one of the six cases inequality rises with the simulated expansion of education.

Panel C shows the effect on the inequality of wages in each sample of simulating both the educational composition and the accompanying education coefficients of another sample. The vertical distance between points with the same coordinate on the horizontal axis represents the differences in inequality among the samples that are attributable to differences in noneducational characteristics and coefficients. But these differences are irrelevant to the analysis; it is the shape of each line that is important. In Tanzania educational expansion and the consequent compression of the educational wage structure cancel each other out; the log variance rises very slightly in two cases and falls very slightly in the other. The move from the educational composition and education coefficients for Tanzania 1980 to those for Kenya 1980 reduces inequality in every case.

There remains a puzzle. In the two-group case we argued that if the variance of wages for the educated exceeds the variance for the uneducated, the variance of the sample peaks when the proportion of workers in the educated group exceeds one-half and that this proportion is greater the smaller is the difference in group mean wages. Panel B, however, suggests the reverse. When the educational compositions for Tanzania 1980 and Kenya 1980 are compared, inequality actually falls when the simulation is conducted on the Kenyan earnings function—that is, the one for which educational wage differences are smallest. But there is not necessarily any inconsistency here. First, it may not be true that the inequality of earnings of the more educated is greater than that of the less educated. Second, the empirical analysis involves five educational categories, whereas the theoretical prediction is based on two.

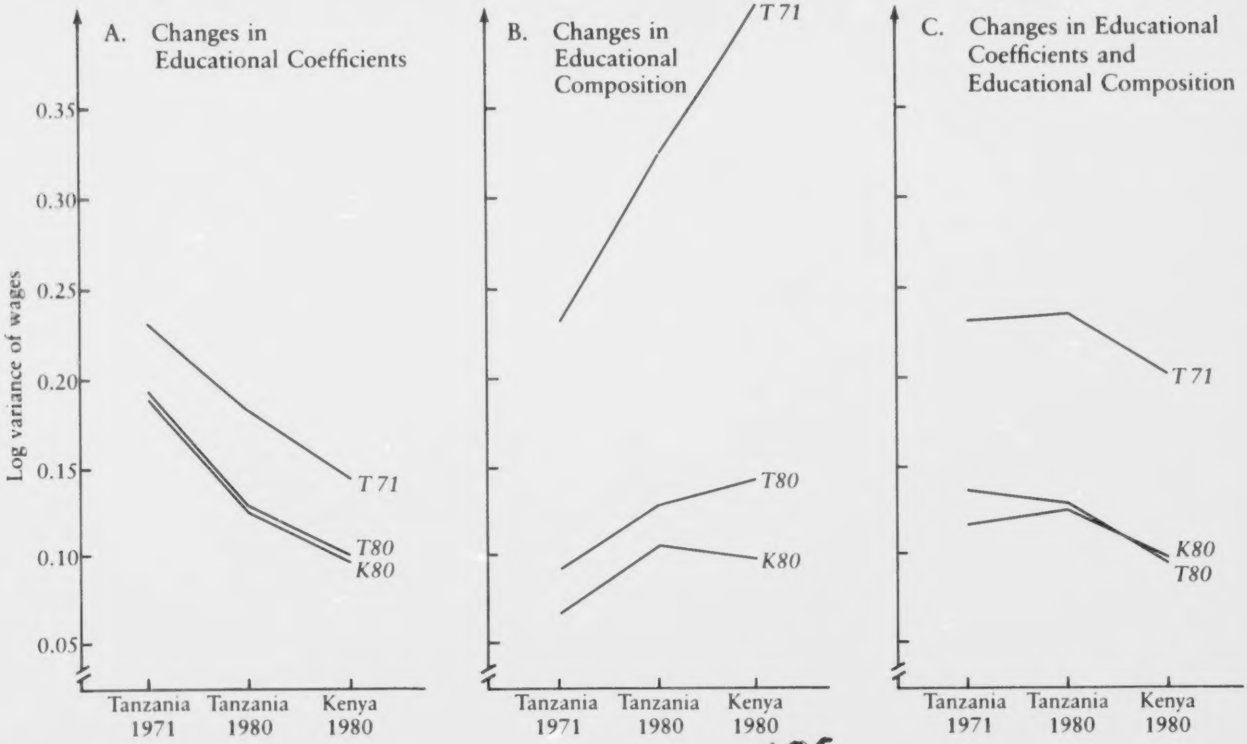
In fact, there is a monotonically increasing relationship between the log variance of earnings and educational level in both Kenya 1980 and Tanzania 1980, and when each sample is divided into two educational

Table 9-2. *The Composition Effect in the Two-Group Case: Parameters for the Estimation of Peak Inequality and Simulations of Inequality*

Parameter	*Tanzania 1971*	*Tanzania 1980*	*Kenya 1980*
σ_1^2	0.467	0.367	0.363
σ_2^2	0.187	0.154	0.240
$\bar{x}_1$	6.709	7.043	6.852
$\bar{x}_2$	5.570	6.389	6.597
p_1	0.120	0.201	0.359
p_1^*	0.608	0.748	1.446
$\delta\sigma^2/\delta p_1$	1.255	0.469	0.141
σ^2_{K80}	0.064	0.074	0.082
σ^2_{T80}	0.084	0.110	0.141

Note: The variable p_1^* is obtained from equation 9-1, and $\delta\sigma^2/\delta p_1$ is obtained from equation 9-3 in the absence of compression effects. The inequality of predicted wages, used in the simulations σ^2_{K80} and σ^2_{T80}, is much less than actual inequality because the predictive equation distinguishes only two educational categories.

Figure 9-1. *The Effects of Educational Expansion on Wage Dispersion in the Manufacturing Sector*



categories instead of five, the log variance of earnings of the educated (those with postprimary schooling) again exceeds that of the uneducated (those with primary or no schooling) in each case. Table 9-2 reproduces for the Kenya 1980 and Tanzania 1980 two-group earnings function the simulation analysis conducted in panel B of figure 9-1; that is, it indicates the effect on inequality of varying educational composition so as to equal that in the other two samples. For both functions an increase in the proportion of educated workers in the total (row p_1 in the table) raises the log variance of predicted wages (shown in rows σ^2_{K80} and σ^2_{T80}, where the subscripts indicate the earnings function being used). It is no longer the case that inequality declines when educational composition is changed from that of Tanzania 1980 to that of Kenya 1980 using the Kenyan earnings function. These results are to be expected because the actual value of p_1 in the two-group case falls well short of the proportion that yields peak inequality in each sample (row p_1^*). Indeed, in the case of the Kenyan earnings function the difference in log means is so small in relation to the difference in log variances that the peak is never reached ($p_1^* > 1$). Thus the flatter slope of the curve based on the Kenyan sample (row $\partial\sigma^2/\partial p_1$) does not indicate that the peak is near.

The implications of this exercise are twofold. First, our evidence and method do not contradict the predictions of the two-group model. Second, the predictions of the two-group model do not necessarily carry over into the more realistic multigroup case.

Educational Expansion and Inequality of Pay in the Wage Sector

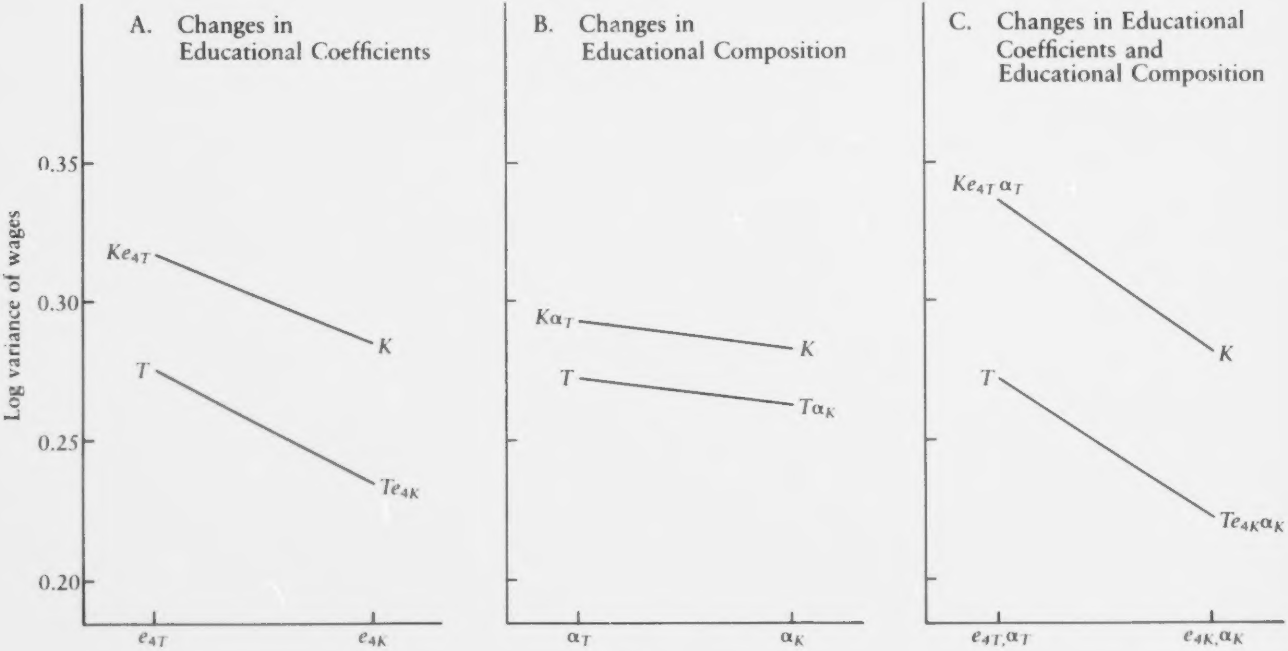
The manufacturing sector is unrepresentative—first, because manual occupations are more important than in the wage sector as a whole and more filtering down has occurred in manufacturing, and, second, because the sector has been relatively unaffected by public sector pay policies. Do our results for manufacturing carry over to the wage sector as a whole? The estimates of η_{sp} for the wage sector in chapter 8 imply a significant compression of the educational structure of wages in response to an increase in the relative supply of secondary leavers. A compression of the wage structure does not, however, necessarily imply a corresponding reduction in wage dispersion. We therefore repeat the exercise carried out above.

A simulation analysis is conducted using an earnings function that corresponds to equation 7-5:

$$W = f(E_i, J_i, E_i \cdot J_i, \mathrm{X}) \tag{9-6}$$

As before, the wage of each worker is predicted from the estimated

Figure 9-2. *The Effects of Educational Expansion on Wage Dispersion in the Wage Sector*



equation and his set of characteristics, and the variance of ln predicted earnings is then measured. When we consider the wage sector as a whole, we cannot ignore the complicating effects of pay policy in Tanzania. In both countries, therefore, the coefficients on the J_i and $J_i \cdot E_j$ terms are set equal to zero; that is, we analyze the market sector.

The compression effect of increasing relative supply from the Tanzanian to the Kenyan level is simulated by substituting the coefficient on E_4 from the Kenyan equation into the Tanzanian predictor equation. The predicted value of ln earnings $(\widehat{W})$ of each secondary leaver is reduced by the amount $e_{4K} - e_{4T}$, where e_4 is the coefficient on E_4, with E_3 as the base category. The composition effect of increasing the relative supply of secondary leavers is simulated by assuming the primary and secondary educational compositions of the Kenyan sample instead of the actual Tanzanian compositions. Again, in applying the Kenyan composition to the Tanzanian sample we use the set of weights α_{jK}/α_{jT}, where α_j represents the proportion of workers in each educational category. In this case the simulation involves an increase in the proportion of workers with secondary education and a decrease in the proportion with primary education. We then combine the compression and composition effects in a single simulation.

Panels A, B, and C of figure 9-2 show the compression effect, the composition effect, and their combined effect. The vertical axis measures inequality, and the horizontal axis indicates whether standardization is on the basis of the Kenyan or the Tanzanian value of e_4, of α, or of e_4 and α. The points K and T indicate predicted inequality in the absence of pay policy. In panel A, Ke_{4T} and Te_{4K} denote that in addition the coefficient on E_4 (e_{4T}, or e_{4K}) has been substituted from the other country. The compression effect of educational expansion has the expected negative sign in both cases. $K\alpha_T$ and $T\alpha_K$ in panel B show the composition effect; inequality declines slightly with educational expansion in both cases. The combined effect (panel C) is therefore to reduce inequality, primarily because of the compression effect.

It is notable in panel C that whereas educational expansion by itself reduces inequality ($Te_{4K}\alpha_K - T = 0.224 - 0.271 < 0$), predicted inequality in the market sector in Kenya is actually higher than in Tanzania ($K - T = 0.281 - 0.271 > 0$). The residual component of the difference between the countries—inequality that arises from other causes, such as a more unequal distribution of determining characteristics—works against Kenya ($K\ Te_{4K}\alpha_K = 0.281 - 0.224 > 0$). Nevertheless, we have shown that education policy over the feasible range can have an important influence not only on the educational structure but also on the interpersonal inequality of wages.

A comparison of figures 9-1 and 9-2 suggests one similarity and two differences between the manufacturing sector and the wage sector as a whole. In Kenya and Tanzania in 1980 the size of the compression effect is roughly the same for the two sectors. The predicted log variance, however, is greater in both countries for the wage sector than for the manufacturing sector. This may be attributable in part to differences in the specifications of the equation, but the main reason is likely to lie in the different characteristics of the two groups of employees. The manufacturing sector contains a more homogeneous labor force, owing to the greater proportion of manual jobs. In the manufacturing sector the effect of moving from the Tanzania 1980 to the Kenya 1980 educational composition is positive in one case and negative in the other, whereas in the wage sector this composition effect is unamibiguously negative. The difference may reflect the higher proportion of educated workers in the wage sector than in the manufacturing sector. The higher proportion means that the hump of the inverse-U-shaped relationship implied by equation 9-1 is more likely to have been passed in the wage sector as a whole.

Conclusions

Is educational expansion an effective tool for reducing the inequality of pay, or should governments that seek to reduce inequality among wage earners rely on direct labor market intervention to achieve this objective? Our results, both for the manufacturing sector and for the wage sector as a whole after the influence of pay policy has been eliminated, suggest that educational expansion can indeed be an effective means of reducing inequality, even without direct government intervention in the labor market. In our East African example, even when the compression and composition effects of educational expansion on inequality work in opposite directions, the equalizing influence of the compression effect predominates.

As expected, the Kenyan pay policy makes little difference to inequality of pay; it reduces the variance of ln wages by only 0.016 to 0.265. This result contrasts with the effects of pay policy in Tanzania, where the index is 0.271 without pay policy but 0.197 with it. The reduction in inequality attributable to pay policy (0.074) is somewhat greater than the reduction achieved by the simulated introduction of the Kenyan policy (0.047). Educational expansion and pay policy in Tanzania could have equalizing effects that are of roughly the same order of magnitude. A judgment on which policy is better must therefore depend on their other benefits and costs.

The Kuznets effect has normally been discussed in relation to the transfer of population from low-income rural areas to high-income urban areas. Such a transfer is not expected to narrow the income gap, either because of labor market imperfections or because the accumulation of human and nonhuman capital in the urban areas tends to widen the gap. We have shown, however, that the expansion of the supply of educated labor in relation to the demand has a powerful compressing effect on the intraurban educational structure of wages. The composition effect of educational expansion can indeed raise intraurban inequality, but the compression effect outweighs it. Thus relative educational expansion reduces inequality, and since this process occurs within the relatively expanding high-income urban sector, it accelerates arrival at the point beyond which economic growth is associated with a reduction in overall inequality.

Note

1. The other independent variables are years of wage employment experience and its square and dummy variables that represent race, sex, employment status, and formal training.

Part IV

EDUCATIONAL EXPANSION AND INEQUALITY OF OPPORTUNITY

CHAPTER 10

Education Policy and Intergenerational Mobility

ECONOMIC INEQUALITY has several dimensions: inequality among individuals at any one time; inequality in the lifetime income of individuals; and inequality of opportunity, which perpetuates inequality from one generation to another. Even if current or lifetime income is unequally distributed there may be perfect intergenerational mobility; in other words, the probability that a member of the next generation will be at a particular position in the distribution of income may be independent of family background. Jencks and others (1972) take the extreme view that family background has little impact on economic success. But in Kenya and Tanzania the concern has been that economic development might transform relatively egalitarian tribal communities into a socioeconomically stratified society in which educated elites would perpetuate themselves from one generation to the next.

In part III we showed that educational expansion can have a powerful effect on the distribution of current incomes. In this part we examine the effect of educational expansion on the distribution of educational opportunities and then on intergenerational mobility. Many studies have documented the relationship between socioeconomic background and differential educational attainment (see, for example, OECD 1971 and Coleman and others 1966 for developed countries and Behrman and Wolfe 1984a, 1984b, and Birdsall 1985 for developing countries). Few, however, have examined the effect of educational expansion on this relationship.

Although it is equalization of opportunities rather than of outcomes that is considered the hallmark of a just society (see Meade 1976), intergenerational mobility is desirable for reasons of efficiency as well as of equity. If position in the economic hierarchy is determined by nonmeritocratic criteria that favor children from particular family backgrounds, resources will be allocated inefficiently. The accepted view is that the distribution of education significantly influences the distribution of economic opportunities; in the words of Horace Mann, "education is the great equalizer." This beneficent view of education as a vehicle for social mobility has been challenged (see Bhagwati 1973 and Bowles 1972, 1973). It may be that when educational opportunities for children from less privileged backgrounds are increased, children from more privileged backgrounds acquire still higher levels of education and thereby maintain their relative position in the socioeconomic hierarchy.

Our analysis is principally quantitative. We assess econometrically the proposition that children from privileged backgrounds tend to monopolize a small school system and that educational expansion disproportionately benefits children from less privileged backgrounds. We then examine the argument that inequality of access can be reduced without expansion because the relationship between family background and access can be altered even within a small system by using more meritocratic selection criteria. We also examine the relationship between the distribution of secondary schooling and intergenerational mobility. Finally we assess whether greater equality in the distribution of places in the middle tier of a school system increases or decreases equality in the distribution of places at the level above. Again, our analysis exploits the natural experiment in East Africa.

A Model of the Expansion and Distribution of Education

In this section we examine the effects of family background on the distribution of school places in unconstrained educational systems and in constrained meritocratic systems. We then explore the consequences of expansion for distribution in both types of system.

Education and Family Background in an Unconstrained System

If education is regarded as an investment, an individual (or his family on his behalf) will seek education if the perceived present value (PV_i) of his net benefits is positive (see Becker 1975). His demand function (D_i) for a given level of schooling (s_j) is therefore

$$\begin{aligned} D_{is_j} &= 1 \quad \text{if} \quad PV_{is_j} > 0 \\ D_{is_j} &= 0 \quad \text{otherwise} \end{aligned} \tag{10-1}$$

and the aggregate demand function is

$$D_{s_j} = \sum_i D_{is_j} \tag{10-2}$$

The present value of attending level s_j for the individual equals discounted lifetime benefits less costs. Since we ignore the nonpecuniary benefits of education, benefits are measured by earnings, which are assumed to be a function of the individual's stock of human capital, C_i. Therefore the benefits from lower secondary education, s_1, depend on H_{is_1}, the increment to the stock of human capital acquired in school during the course of s_1. The determinants of H_{is_1} are shown in the educational production function:[1]

$$H_{is_1} = F(R_i, I_{is_1}, C_{is_0}, Q_{is_1}) \tag{10-3}$$

The increase (H_{s_1}) in the stock of human capital—and, consequently, in earnings—brought about by education at level s_1 depends positively on four factors: Q_{s_1}, the quality of s_1 education; C_{s_1}, the amount of human capital acquired both in and out of school before s_1;[2] I_{s_1}, the amount of human capital acquired out of school during the period of s_1;[3] and R, native ability.

There are several ways in which the educational level of parents can influence the demand for education for their children and thus the composition of enrollment. Educated parents are likely to make larger out-of-school human capital investments in their children (see Becker 1972 and Leibowitz 1973). Such investments may be costless for the educated; skills may be transferred from parent to child in the course of daily interaction without conscious effort or diversion of time from other activities. By contrast, such transfer of skills may be beyond the power of uneducated parents or available only in the market at a price. Moreover, the educated live in areas in which the quality of schooling is above average, and educated parents may have higher natural ability, which their children inherit. The benefits of schooling for children of the educated are likely to be higher because of the contributions that out-of-school investments, school quality, and ability make to value added per year of schooling.

On the cost side, educated parents generally earn more. They are therefore better able to finance schooling from income or wealth and, given capital market imperfections, can borrow more easily and at a lower interest rate. The educated tend to live and work in urban areas, where the costs of transport to school are lower. Because of the relative lack of employment opportunities for children in urban areas and the greater social stigma attached to child labor there, the opportunity cost of education may be lower for the children of the educated.

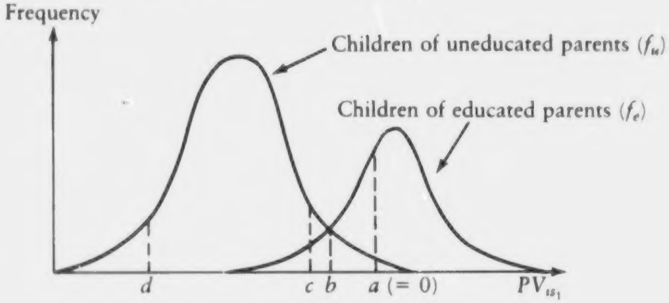
The higher benefits and lower costs of education for children of educated parents imply that, other things being equal,

$$\overline{PV}_{s_1 f_e} > \overline{PV}_{s_1 f_u}$$

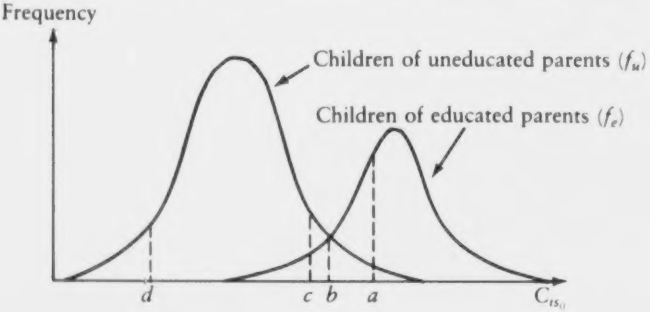
where a bar indicates a mean value and f_e and f_u indicate educated and uneducated parents, respectively. Figure 10-1, panel A, shows the distributions of the two groups of children according to present value of lower

Figure 10-1. *Demand for and Access to Lower Secondary Education (s_1), by Family Background*

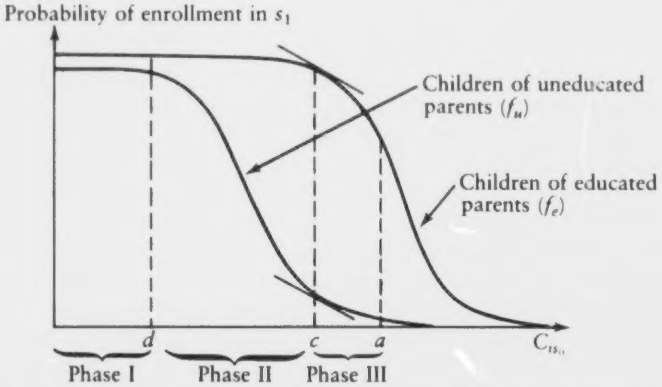
A. The Distribution of Present Value of Lower Secondary Education in an Unconstrained System



B. The Distribution of Human Capital Acquired Prior to Lower Secondary Education in a Constrained Meritocratic System



C. The Distribution of Lower Secondary Enrollment in an Expanding System



Note: S_1, lower secondary education; PV_{is_1}, present value of investment in lower secondary schooling.

secondary education (PV_{is_1}), on the assumption that the children of educated parents constitute the smaller group. The distribution by present value for children of educated parents is to the right of that for children of uneducated parents, for the reasons noted above. Point *a* on the horizontal axis signifies a present value for s_1 schooling of 0; that is, it demarcates those who demand s_1 schooling from those who do not. The proportion of children for whom the present value of s_1 schooling is positive is higher for the children of the educated than for the children of the uneducated. Where market forces determine the quantity and distribution of education, the children of the educated are thus at an advantage.

Enrollment and Family Background in a Constrained Meritocratic System

In a freely competitive market for education the equilibrium condition is that demand is exactly satisfied; that is,

$$P_{is_j} = D_{is_j} \tag{10-4}$$

where P_{is_j} is the probability (with value 0 or 1) that the individual will attend educational level *j*. The aggregate probability of (that is, proportion in) enrollment for the relevant age group (with N_{s_j} members) is

$$P_{s_j} = \frac{\Sigma_i P_{is_j}}{N_{s_j}} = \frac{D_{s_j}}{N_{s_j}} \tag{10-5}$$

If school places are rationed, some individuals for whom $D_{is_j} = 1$ will nevertheless not attend school.[4] In this case the individual's probability of enrollment will depend on his probability of acceptance (π_{is_j}) as well as on his demand.

$$P_{is_j} = \pi_{is_j} D_{is_j} \tag{10-6}$$

The aggregate probability of enrollment is then the product of aggregate demand and the probability of acceptance:[5]

$$P_{s_j} = \frac{\Sigma_i (\pi_{is_j} D_{is_j})}{N_{s_j}} \tag{10-7}$$

The probability of acceptance depends on the rationing system. We define the system as meritocratic if π_{is_1} depends simply and positively on the human capital that the individual possesses before s_1—that is, on C_{is_0}. We refer to this accumulated human capital as achievement. In that case,

$$\begin{aligned} (10\text{-}8)\quad \pi_{is_1} &= 1 \quad \text{if} \quad E_{s_1} \geq a_i D_{s_1} \\ \pi_{is_1} &= 0 \quad \text{otherwise} \end{aligned}$$

where

E_{s_1} = the number of s_1 places to be filled

a_i = the percentile (ordered from the top) of the distribution of human capital of s_1 leavers with $D_{is_1} = 1$ in which individual i is found

For instance, if there is one s_1 place available for every ten applicants ($E_{s_1}/D_{s_1} = 0.1$), the probability of promotion to s_1 is unity for students in the top 10 percent of the distribution ($a_i \leq 0.1$) and zero for those for whom $a_i > 0.1$.

Under a meritocratic selection criterion, whether probabilities of enrollment differ by family background depends on whether the distributions by achievement of the two groups differ. In figure 10-1, panel B, the horizontal axis is human capital acquired prior to secondary school (C_{is_0}). If the distribution by achievement of the children of the educated is located to the right of that of the children of the uneducated, the probability of acceptance will be greater for the former than for the latter. $\pi_{s_1 f_e} > \pi_{s_1 f_u}$. Point a now signifies the achievement level necessary to ensure acceptance. The proportion of s_0 leavers with $C_{is_0} > W$ is higher among children of educated parents. For this to occur, it is sufficient that educated parents provide more out-of-school human capital for their children than do uneducated parents or that they send their children to better schools. The conclusion would be strengthened if the children of educated parents also inherited a higher average natural ability.

Educational Expansion at One Educational Level and Its Effects on Distribution

Assume that in both unconstrained and constrained meritocratic school systems the probability of attending s_1 is greater for children of educated parents than for children of uneducated parents, for the reasons enumerated above. What consequences does expansion of the aggregate enrollment ratio at educational level s_1 have for the distribution of s_1 places by family background? Our measure of the inequality of access to s_1 is the difference between the proportions of each group enrolled in s_1, that is, $P_{s_1 f_e} - P_{s_1 f_u}$.

An increase in school places in a constrained meritocratic system is equivalent to reducing the achievement level required for acceptance into s_1—that is, point a in panel B is moved to the left. If the original size of the system was small, the distributional effect need not be egalitarian.

As P_{s_1} is expanded from a small base, the distribution of places in s_1 is likely to pass through various phases (panel C): inequality first increases (phase I), then decreases (phase II), and finally becomes constant (phase III). The positions and slopes of the curves in panel C are derived from the distributions in panel B; thus the slopes of the curves in panel C are steepest at the modes of the distributions in panel B. The inequality of access is the vertical distance between the curves in panel C.

At first, as expansion occurs, more children of the educated than of the uneducated are admitted and the probability of enrollment rises more steeply for children of educated parents than for children of uneducated parents. That is, $P_{s_1/f_e} - P_{s_1/f_u}$ increases; inequality of educational opportunity is exacerbated. To the left of the point at which the curves in panels A and B cross, more children of uneducated than of educated parents are aided by further expansion, but inequality continues to increase because the educated group is smaller than the uneducated group. At point *c* the slopes of the two curves in panel C are the same and inequality is at a maximum. To the left of point *c* the probability of schooling for children of uneducated parents increases more than for children of educated parents, and hence inequality begins to decrease. Phase II ends at point *d*, which corresponds to $PV_{is_1} = 0$. Beyond point *d* (phase III), no further expansion in the number of places available would increase enrollment unless measures were also taken to increase the demand for s_1 education (D_{is_1/f_u}), which in this model is held constant. Inequality of access to s_1 thus does not change.

The distribution of s_1 places is likely to pass through the same three phases if an unconstrained system expands owing to, for example, an increase in government subsidies. The pattern might differ if expansion were the result of a policy of subsidies that specifically benefited children from deprived backgrounds. The effect of expansion can be seen by shifting the distributions of PV_{s_1} to the right in panel A. The same logic applies as when point *a* was moved to the left.

Socioeconomic Background and Educational Attainment

The model predicts a positive relationship between socioeconomic background and educational attainment. Table 10-1 shows a strong correlation in both countries between father's education and the level of education achieved by the employee; as father's education increases so does the percentage of children attaining high levels of education. For example, in Kenya 36 percent of the employees whose fathers had no education received secondary or higher education, whereas for those whose fathers had primary education the corresponding figure is 66 percent and for those whose fathers had secondary or higher education it is 84 percent. These percentages can be seen as roughly indicating the probability,

Table 10-1. *Education of Employees, by Father's Education*
(percent)

	Father's education					
	Kenya			*Tanzania*		
Own education	*None*	*Primary*	*Postprimary*	*None*	*Primary*	*Postprimary*
None	12	0	0	20	3	1
Standards 1–6	22	10	3	31	12	1
Standards 7–8	30	24	13	28	39	11
Forms 1–4	33	50	20	14	33	60
Post–form 4	3	16	64	7	13	27
Number of cases	1,015	591	154	77	799	140

given the education of the father, of getting at least to secondary school. Clearly, for children from well-educated family backgrounds the probability is high. This means that the children of fathers with less than secondary education are competing for the secondary places that remain after the children of fathers with secondary education have, in effect, claimed their places. It suggests, in accordance with our model, that the size of the secondary system, and hence the size of the residual, is a crucial determinant of the probability that children from less privileged family backgrounds will go to secondary school.

Table 10-2 shows that there is a strong positive relationship between the educational level of either parent and the years of education of the employee. The latter is calculated from level of education attained and is not increased by repetition of classes. In both countries increasing either parent's education from none to primary, while the other parent's education is held constant at none, raises the mean length of education of the employee by more than two years. Similarly, raising the education of either parent from primary to secondary and higher, while the education of the other parent is held at the primary level, raises the mean length of education of the employee by a year and a half. Interaction effects are captured along the diagonals, which show the beneficial effect of increasing both parents' education. The difference between the socioeconomic extremes of both parents with no education and both with postprimary education is high, about six years of education for the employee.

The effect of mothers' education, independent of fathers' education, on the education of children has already been noted. But in practice mothers' education is not independent. People tend to engage in assortative mating—to choose marriage partners with socioeconomic characteristics similar to their own. Clearly, access to secondary school and, more

Table 10-2. *Employees' Mean Years of Education, by Mother's and Father's Education*

	Mother's education					
	Kenya			*Tanzania*		
Father's education	*None*	*Primary*	*Postprimary*	*None*	*Primary*	*Postprimary*
None	6.9	9.3	. . .	5.8	8.1	. . .
	(959)	(45)		(736)	(30)	
Primary	9.0	10.5	12.0	8.3	9.5	11.9
	(317)	(258)	(6)	(438)	(345)	(9)
Postprimary	11.0	12.0	13.1	8.9	11.8	11.7
	(55)	(65)	(24)	(31)	(98)	(11)

. . . Zero or insignificant.

Note: Figures in parentheses are numbers of cases.

generally, the degree of inequality in the distribution of educational opportunity by socioeconomic background will be strongly affected by the propensity of individuals to marry their educational peers.

Let us assume that the adult population is divided into two groups, the educated (*E*) and the uneducated (*U*), and that males and females are divided equally between them. If children with two *U* parents have a zero probability of obtaining secondary education, children with one *E* parent a 0.5 probability, and children with two *E* parents a probability of 1, the distribution of secondary educational opportunities for the children will depend on the mating behavior of their parents. The probabilities are as follows.

- *Perfectly assortative mating.* All the *E*s marry *E*s and all the *U*s marry *U*s. The children of uneducated parents have a probability of 0 of receiving secondary education, and the children of educated parents have a probability of 1 of receiving secondary education.
- *Antiassortative mating.* The *E*s marry *U*s and, since all children have one parent with education, they all have a probability of 0.5 of receiving secondary education.
- *Random mating.* Half of the *U* males marry *U* females and half marry *E* females. Similarly, half of the *E* males marry *U* females and half marry *E* females. The probabilities that the children will receive secondary education are as follows: 0 for the 25 percent whose parents have no education, 1 for the 25 percent with two educated parents, and 0.5 for the 50 percent with one educated parent.

This example shows that inequality in the distribution of educational opportunity in the next generation will be greatest if mating is perfectly assortative. The distribution will be less unequal if mating is random and most equal if mating is antiassortative.

In fact, the survey evidence suggests that mating behavior falls somewhere between perfectly assortative and random. In the Kenyan sample 95 percent of fathers who had no education had wives with no education; 54 percent of fathers with primary education and 37 percent of those with postprimary education had wives with no education. In Tanzania the percentages were similar. Perfectly assortative mating is in any case not possible because there are fewer educated women than educated men. The picture is more dramatic when we consider the mothers of respondents. In Kenya nearly 90 percent of the small pool (23 percent of the total) of women with at least primary education were married to men with at least primary education; the tendency is no weaker in Tanzania. Thus assortative mating was constrained in the past by the limited educational opportunities for girls. Greater sexual equality in access to education and the advantages of having educated parents mean that the propensity of the educated to marry among themselves will reinforce the unequal distribution of educational opportunity in the next generation.

These simple cross-tabulations suggest a relationship between the education of a worker and that of his parents. They are not conclusive, however, because they do not isolate the influence of parental education while other determinants of educational attainment are held constant. For instance, a young worker with young parents is likely to have more education than an older worker, and his parents are likely to have more education than those of an older worker. Thus the relationship might be simply a result of the expansion of the education system and not of any independent effect of parents' education on the educational attainment of their children. To isolate this independent effect, multivariate analysis is necessary. The probit functions that we estimate measure the independent effects of a variety of determinants of educational attainment and show how the relationship between family background and educational attainment has changed from one cohort of workers to the next. We are therefore able to examine the effects of educational expansion on the distribution of educational opportunities.

The Expansion and Distribution of Primary Education

In both Kenya and Tanzania the primary school system can be characterized as nonmeritocratic, in that access is not determined by cognitive achievement or natural ability, and unconstrained, in that before the government commitment to universal primary education there were no legal prohibitions on local or private initiatives and regulation was not onerous. Thus the model predicts, for the various reasons enumerated, that the present value of primary education (PV_{s_0}), and hence the demand for primary schooling and the probability of completing it, will vary positively with the educational level of parents in both countries. A second set of predictions concerns the effect of educational expansion on the distribution of primary schooling. Since both Kenya and Tanzania are approaching universal primary education, we would expect them to be in phase II of their expansion, and the model predicts that the probabilities have become more equal in both countries.

The probit function that we estimate measures the impact of family background on the probability of completing primary school and thus provides a test of our first prediction. It also measures the interaction between increases in the aggregate enrollment rate and the educational level of parents and so tests our second prediction. Table 10-3 presents maximum likelihood estimates of the parameters in the following reduced form equation:

$$\text{Prob}(Y = 1) = \Phi(\mathbf{X}'\beta) \tag{10-9}$$

where Y is a dichotomous variable that takes the value 1 where the individual completed primary school or higher and 0 otherwise, $\mathbf{X}$ is a vector of exogenous variables, and $\Phi(\mathbf{X}'\beta)$ is the cumulative unit normal distribution function. Note that the coefficients β do *not* represent the marginal change in the probability associated with each of the independent variables, as is the case with the simple linear probability model.

The exogenous variables are:

F_j = a set of four dummy variables that signify the educational level of the individual's parents. In the base subcategory (F_1) both parents are uneducated; F_2 signifies one parent with no education and one with primary education; F_3 signifies both parents with primary education or one parent with secondary education or higher and one with no education; and F_4 signifies one parent with primary education and one parent with secondary education or higher or both parents with secondary education or higher.

P_{s_0} = the aggregate enrollment rate in standard 7 (or, before 1966, 8) when the individual was 13 years old, as measured by the proportion of all 13-year-olds enrolled in standard 7 (or, before 1966, 8) in the year when the individual was 13.

$P_{s_0} \cdot F_j$ = a set of interaction variables.[6]

B = a dummy variable that takes the value 1 if the individ-

Table 10-3. *Probit Functions and Predicted Probabilities for Completion of Primary School, by Family Background*

		Probit coefficient			*Predicted probability*			
Item	*Mean*	*(1)*	*(2)*	*Year*	F_1	F_2	F_3	F_4
Kenya (1,689 cases)								
P_{s_0}	32.414	0.014***	0.014***	1960[a]	0.50	0.69	0.87	1.0
F_2	0.214	0.412***	0.388***	1961	0.51	0.72	0.88	1.0
F_3	0.164	0.954***	1.034***	1965	0.79	0.89	0.95	1.0
F_4	0.046	1.589***	12.157	1970	0.82	0.91	0.96	0.99
B	0.035	0.323	0.319	1975	0.84	0.92	0.97	0.90
T	0.027	0.147	0.097	Average	0.69	0.82	0.92	1.0
$P_{s_0}F_2$	—	—	0.001					
$P_{s_0}F_3$	—	—	−0.002					
$P_{s_0}F_4$	—	—	−0.178					
Constant	—	0.021	0.013					
χ^2	—	264.7	268.9					

		Probit coefficient			*Predicted probability*			
Item	*Mean*	*(1)*	*(2)*	*Year*	F_1	F_2	F_3	F_4
Tanzania (1,602 cases)								
P_{s_0}	10.838	0.047***	0.057***	1960[a]	0.31	0.69	0.80	0.94
F_2	0.256	0.769***	1.031***	1961	0.35	0.70	0.82	0.94
F_3	0.199	1.257***	1.342***	1965	0.50	0.77	0.89	0.96
F_4	0.045	1.798***	2.075***	1970	0.73	0.85	0.96	0.98
B	0.051	−0.345**	−0.334**	1975	0.93	0.93	0.99	0.99
T	0.024	0.856**	0.840**	Average	0.50	0.77	0.89	0.96
$P_{s_0}F_2$	—	—	−0.028**					
$P_{s_0}F_3$	—	—	−0.010					
$P_{s_0}F_4$	—	—	−0.028					
Constant	—	−0.521***	−0.602**					
χ^2	—	454.5	463.6					

— Not applicable.

* Significant at the 10 percent level.

** Significant at the 5 percent level.

***Significant at the 1 percent level.

Note: P_{s_0}, probability of completing primary school; F_2, one parent with no education and one with primary; F_3, both parents with primary or one with secondary or higher and one with none; F_4, one parent with primary and one with secondary or higher or both with secondary or higher; B, urban birth; T_1, non-African race. Column numbers identify different equation specifications.

a. The category 1960 includes all respondents who were 13 in 1960 or in prior year. The probabilities can be interpreted as weighted averages for all years prior to 1961.

ual was born in an urban area and 0 if the individual was born in a rural area

T a dummy variable that takes the value 1 if the individual is non-African and 0 if the individual is African.

Table 10-3 also presents the probabilities of completing primary school predicted by the estimated functions for the four family background groups.[7]

The first prediction of the model is clearly borne out: in both countries the coefficients on the family background variables increase monotonically with the educational level of the parents and in column 1 are all significant at the 1 percent level. Five of six are significant at that level in column 2. The average predicted probability of completing primary school rises from 0.69 in Kenya and 0.50 in Tanzania for children with uneducated parents (F_1) to 1.0 in Kenya and 0.96 in Tanzania for children with at least one parent with secondary education (F_4).

The second prediction is also confirmed: for children of parents with secondary education the predicted probability of completing primary school remains constant at or near unity throughout the period under consideration, whereas for children of uneducated parents the probability rises markedly. For children of uneducated parents the predicted probability of attendance prior to 1961 was 0.50 in Kenya and 0.31 in Tanzania. The probability rises to 0.84 in Kenya and 0.93 in Tanzania in 1975. As the model led us to expect for an education system in phase II, in both countries expansion of primary schooling more than proportionately benefited the children of those who are relatively low in the socioeconomic hierarchy.

The Expansion and Distribution of Lower Secondary Education

Kenya's lower secondary system has expanded faster than Tanzania's and is much larger. The lower secondary system in Tanzania is the more meritocratic of the two in the sense that ability to pay determines access in a smaller proportion of cases. In both countries performance on the primary-leaving examination is the main determinant of access to government secondary schools, whereas ability to pay is the main determinant of access to private schools. In 1976, 71 percent of form 1 students were enrolled in private schools in Kenya; in Tanzania the comparable figure was 40 percent. Our surveys indicate that in both countries nearly all primary leavers wanted at the time to continue. Inability to pay school fees was the main reason given for not attending secondary school in Kenya, while in Tanzania insufficiently high grades was the main reason.

In Tanzania there has been a marked change in the importance of the reasons for not continuing beyond primary school; financial reasons have become less important and failure in exams more important.

Has meritocratic selection proved an effective substitute for educational expansion as a means of reducing inequality in the distribution of schooling? Or has neither expansion nor greater meritocracy reduced inequality?

Table 10-4 presents estimates of lower secondary probit functions for the whole sample and the predicted probabilities of attending forms 1–4 by family background. The only differences in specification between these functions and those in table 10-3 are in the dependent variable and the aggregate enrollment ratio. Y_{is_1} now takes the value 1 if the individual attended lower secondary school and 0 otherwise. P_{s_1} is the aggregate probability of attending secondary school when the individual was 14 years old, as measured by the proportion of all 14-year-olds enrolled in form 1 at that time.

In both Tanzania and Kenya the coefficients on the family background variables increase monotonically with parents' educational level. All are significant at the 1 percent level. The move toward greater meritocracy in Tanzania has not made access to lower secondary school independent of family background. The table of predicted probabilities shows that the distribution of lower secondary opportunities is more equal in Kenya than in Tanzania.[8] The average probability that a child of the most educated parents (F_4) will attend lower secondary school is high—0.85 in Kenya and 0.82 in Tanzania. The predicted probability for a child of uneducated parents (F_1) is much lower in both countries, but in Tanzania, at 0.16, it is less than half the probability in Kenya, 0.36.

The changes in probabilities with time confirm that Kenya is clearly in the second, increasingly egalitarian, phase of expansion of its secondary system. Before 1961 the structure of probabilities by family background was much the same in Kenya as in Tanzania; in both countries the predicted probability that a child of the most educated parents would attend lower secondary school was four or more times that for a child of uneducated parents. In 1975, roughly a decade after the two countries' policies regarding secondary schooling diverged, the structure of probabilities was markedly more compressed in Kenya. In both countries the probability that a child of the most educated parents would attend lower secondary school remained roughly constant at a high level; in Kenya the predicted probability of attendance for a child of uneducated parents rose sharply, from 0.21 before 1961 to 0.73 in 1975. In Tanzania the probability increased only from 0.13 to 0.21 during the same period.

These results suggest that Kenya's policy of allowing the enrollment ratio to increase has succeeded in reducing inequality of access to second-

Table 10-4. *Probit Functions and Predicted Probabilities for Completion of Lower Secondary School, by Family Background*

Item	*Mean*	*Probit coefficient*		*Year*	*Predicted probability*			
		(1)	*(2)*		F_1	F_2	F_3	F_4
Kenya (1,688 cases)								
P_{s_1}	8.721	0.061***	0.068***	1960	0.21	0.33	0.57	0.83
F_2	0.214	0.378***	0.384***	1961	0.25	0.38	0.61	0.84
F_3	0.164	0.824***	1.049***	1965	0.36	0.50	0.68	0.85
F_4	0.045	1.283***	1.875***	1970	0.54	0.67	0.78	0.87
B	0.035	0.583**	0.593**	1975	0.73	0.83	0.87	0.89
T	0.027	0.438*	0.364	Average	0.36	0.50	0.69	0.85
$P_{s_1}F_2$	—	—	−0.002					
$P_{s_1}F_3$	—	—	−0.024*					
$P_{s_1}F_4$	—	—	−0.054*					
Constant	—	−0.919***	−0.971***					
χ^2	—	371.5	377.5					

Item	Mean	Probit coefficient		Year	Predicted probability			
		(1)	(2)		F_1	F_2	F_3	F_4
Tanzania (1,602 cases)								
P_{s_1}	2.422	−0.016	0.101**	1960	0.13	0.39	0.55	0.81
F_2	0.256	0.577***	1.051***	1961	0.15	0.36	0.50	0.81
F_3	0.198	0.868***	1.479***	1965	0.17	0.33	0.46	0.82
F_4	0.045	1.939***	2.058***	1970	0.19	0.30	0.40	0.83
B	0.051	−0.416***	−0.419**	1975	0.21	0.28	0.38	0.83
T	0.024	0.761**	0.722***	Average	0.16	0.35	0.48	0.82
$P_{s_1}F_2$	—	—	−0.0202***					
$P_{s_1}F_3$	—	—	−0.241***					
$P_{s_1}F_4$	—	—	−0.067					
Constant	—	−0.955***	−1.216***					
χ^2	—	229.6	241.8					

— Not applicable.
* Significant at the 10 percent level.
** Significant at the 5 percent level.
***Significant at the 1 percent level.

Note: P_{s_1}, probability of completing lower secondary school. For other definitions, see notes to table 10-3. Column numbers identify different equation specifications.

Table 10-5. *Probabilities of Intergenerational Mobility*

Parents' education	*Unskilled manual*	*Semiskilled manual*	*Skilled manual*	*Clerical*	*Supervisory*	*N*	*Percent*
Kenya							
F_1	0.23	0.30	0.25	0.18	0.04	998	57.8
F_2	0.22	0.21	0.20	0.31	0.06	365	21.1
F_3	0.10	0.19	0.18	0.38	0.15	285	16.5
F_4	0.05	0.03	0.13	0.44	0.34	61	3.5
F_5	0.00	0.05	0.05	0.37	0.53	19	1.1
N	342	434	381	432	139	1,728	—
Percent	19.8	25.1	22.0	25.0	8.1	—	—
Tanzania							
F_1	0.26	0.31	0.24	0.13	0.05	826	50
F_2	0.15	0.24	0.23	0.27	0.11	417	25
F_3	0.10	0.19	0.19	0.37	0.15	325	19
F_4	0.06	0.08	0.05	0.60	0.29	76	4
F_5	0.00	0.00	0.00	0.37	0.62	8	0
N	313	428	364	389	158	1,652	—
Percent	18.9	25.9	22.0	23.5	9.5	—	—

— Not applicable.

Notes: In this table: F_4, one parent with primary education and one with secondary or higher education; F_5, both parents with secondary or higher education. Other variables are as defined in table 10-3.

Rows sum to 100. The columns signify the proportion of employees in each occupational category, by parents' educational level.

ary schooling. Tanzania's policy of restricting secondary school growth but attempting to make access less dependent on family background through the use of meritocratic selection criteria has been less successful. The intensely competitive meritocratic selection system appears to be as effective in denying access to secondary school to children from poor families as were fees in earlier years.[9]

Levels of Intergenerational Mobility

As a result of Kenya's education policies, a higher proportion of people from poor backgrounds are now receiving secondary education there than in Tanzania. We might expect the greater equality in the distribution of lower secondary schooling in Kenya to lead to a smaller role for family background in determining position in the socioeconomic hierarchy than in Tanzania. Has this in fact occurred?

Let P_{ij} denote the probability that an individual with parents in class i is in class j. Then, assuming that the system is closed, $\Sigma_j P_{ij} = 1$ for all i. Let $p_j(T)$ be the probability that the family line is in class j at time T. Then

$$p_j(T + 1) = \sum_i P_i(T) P_{ij} \tag{10-10}$$

This Markov chain model of mobility rests on the assumption that the probability that an individual will move to a position in the socioeconomic hierarchy—a class—different from his parents' depends only on his parents' class and not directly on the classes of previous generations.

Table 10-5 uses our cross-sectional data on parent-child pairs to present the matrix of probabilities of intergenerational mobility for Kenya and Tanzania.[10] The employee's occupation indicates his economic status (expected lifetime earnings), and parents' level of education indicates his parents' economic status. If there were perfect mobility, the row percentages would be similar and would be close to the overall occupational distribution shown in the bottom line of the table. In fact, there is a marked difference by family background in the probabilities of attaining high-status jobs. In both countries the probability that children will gain access to the top two categories rises monotonically with the educational level of their parents.

Since the overall occupational distribution in Kenya and Tanzania is almost identical, we can roughly compare mobility in the two countries by directly comparing the probabilities of attaining higher-status occupations for the various family background groups. Kenya and Tanzania show striking similarities in this respect. For example, for children whose parents had no education, the probability of getting a white-collar job (clerical, professional, or managerial) is 0.22 in Kenya and 0.18 in Tanzania. If both parents had primary education, the probability is 0.53 in

Kenya and 0.52 in Tanzania; if both parents had secondary education, the probability is 0.90 in Kenya and 0.99 in Tanzania. It appears that although children from less educated households have a much higher probability of getting secondary education in Kenya than in Tanzania, their probability of being in white-collar occupations is almost the same in both countries.

An aggregate measure confirms the impression that degrees of mobility are similar in Kenya and Tanzania. In the following index of mobility, developed by Bartholomew (1973), movement of children to classes different from their parents' is weighted by the distance moved and the size of each class in the parental generation.

$$M = \sum_i \sum_j f_i P_{ij} \, \mathrm{T} i - j \mathrm{T} \qquad (10\text{-}11)$$

where

$$f_i = n_i / \sum_i n_i$$

and *n* signifies the number in the classes of the parents' generation. Complete immobility—where the transition matrix is the identity matrix and hence the value of the index is equal to 0—is only possible if the proportions of people in the various classes remain unchanged from one generation to the next. In Kenya and Tanzania the size of the classes is not the same across generations, which implies that the value of the index in the situation of least possible mobility, M_{lm}, is not equal to 0 and can differ between Kenya and Tanzania. The magnitude of the index in the situation of perfect mobility, M_{pm}, will also differ between the two countries because of differences in the class composition of the parental generation.

To compare intergenerational mobility in Kenya and Tanzania, we standardize the actual measure of mobility by the values for the hypothetical situations of perfect and least mobility.[11] Our standardized index is

$$M^* = \frac{M - M_{lm}}{M_{pm} - M_{lm}} \qquad (10\text{-}12)$$

which shows the position of *M* between the two extreme points as a fraction of the distance between them. The actual mobility measure (*M*) is 1.331 in Kenya and 1.247 in Tanzania, whereas the standardized mobility measure (M^*) is 0.59 in Kenya and 0.54 in Tanzania.[12] The values of M^* are similar in Kenya and Tanzania.

Educational Expansion and the Distribution of Post–Form 4 Education

The more equal distribution of lower secondary education in Kenya than in Tanzania has not brought about greater intergenerational mobility. In this section we formalize and test the hypothesis that children from privileged backgrounds tend to remain one step ahead in educational attainment. Extensions of our model demonstrate that equalization of opportunities at the lower secondary level need not equalize opportunities at the next level—that, indeed, it may lead to greater inequality in the distribution of post–form 4 education.

In the second phase of the expansion of s_1 outlined above, $P_{s_1fe} - P_{s_1fu}$ declines. This equalization of opportunities at the s_1 level equalizes the demand for upper secondary, or s_2, places (on the assumption that s_2 education is highly subsidized so that $D_{is_2} = 1$ for all s_1 completers). That is, $D_{s_2f_e} - D_{s_2f_u}$ falls as P_{s_1}, and hence $D_{s_2f_u}$, increases. Since

$$P_{s_2f_i} = \pi_{s_2f_i} \cdot D_{s_2f_i}$$

whether reducing inequality in the demand for post–form 4 schooling reduces inequality of enrollment depends on the changes in the probabilities of promotion. (If promotion to post–form 4 were random, the equalization of demand would clearly lead to increasing equality of enrollment.) In a meritocratic system the probabilities of promotion also change in a predictable way as the lower secondary system expands.

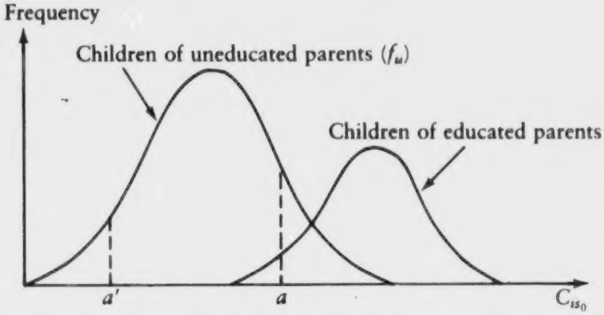
Consider first the situation in which the post–form 4 system remains the same size. As lower secondary enrollments increase, promotion rates have to fall to adjust to the increased demand for a constant number of s_2 places. To examine the effect of this on inequality of access to s_2, we have to examine the changing achievement levels of children from different family backgrounds both before entry to and on completion of s_1. Panel A of figure 10-2 shows the two family background groups distributed by achievement prior to s_1. When the number of s_1 places is small, the achievement required for promotion to s_1 is high (point *a*). A larger number of places permits a lower minimum achievement level (for example, all those above *a*′ are promoted).[13]

The distributions and means of $C_{is_0f_e}$ and $C_{is_0f_u}$ are shown for a small system (panel B, point *a*) and for a large system (panel C, point *a*′). When s_1 is small, only the highest achievers among the children of uneducated parents enter the s_1 system. Their achievement prior to s_1 therefore compares favorably with that of the children of educated parents: $\bar{C}_{s_0f_u}$ is not much less than $\bar{C}_{s_0f_e}$. The expansion of s_1 draws into the system primarily those children of uneducated parents who were previously excluded by their relatively low achievement. The expansion has little effect on the enrollment of the children of educated parents or on their mean achievement prior to s_1: $\bar{C}_{s_0f_e}$ is only marginally lower than in panel B. By contrast, $\bar{C}_{s_0f_u}$ is now markedly lower.

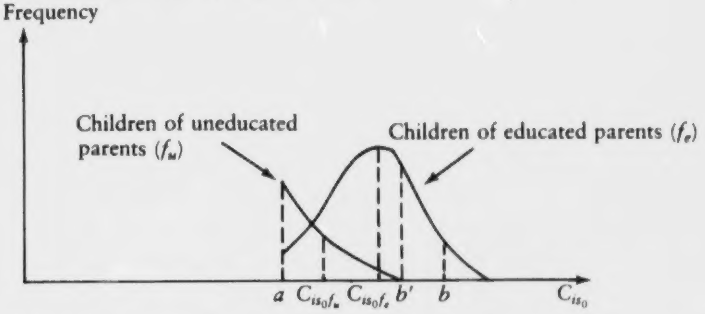
If achievement prior to s_1 is a good predictor of achievement prior to s_2 (as is true if the production functions for s_0 and s_1 are similar and if out-of-school investments prior to s_1 are closely correlated with such investments during s_1), the expansion of s_1, whether in a constrained or

Figure 10-2. *The Distribution of Post–Form 4 Education, by Family Background*

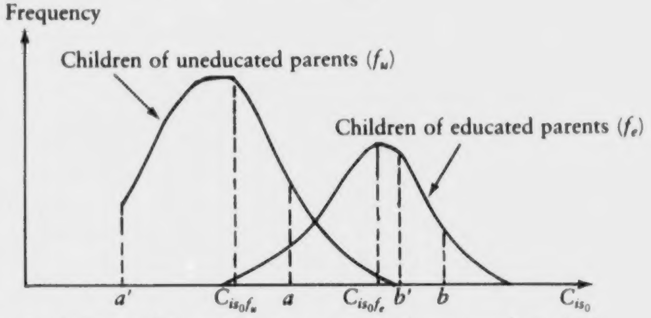
A. By Achievement Prior to Secondary School



B. If the Lower Secondary System Is Small



C. If the Lower Secondary System Is Large



Note: C_{is_0}, human capital acquired prior to entering lower secondary school.

an unconstrained system, has countervailing effects on the distribution of s_2. The increase in the number of s_1 graduates from uneducated backgrounds tends to increase their relative demand for s_2 places. On the other hand, the decline in their mean achievement ($\bar{C}_{is_1f_u}$) in relation to $\bar{C}_{is_1f_e}$ reduces their relative promotion rate. The former tendency equalizes the distribution of s_2 places and the latter tendency makes the distribution less equal. If point *b* is the minimum achievement level (C_{is_1}) required for promotion to s_2, the family background of those with achievement above *b* is the same when s_1 is small (panel B) as when it is large (panel C). There is no distributional gain in s_2 despite the expansion and distributional gain in s_1.

Now suppose that the increased demand for s_2 as a result of the expansion of s_1 leads to an accommodating expansion of s_2. A decline in the minimum achievement level from *b* to *b′* in panel C leads to a larger increase in s_2 enrollment for the children of the educated than for those of the uneducated if s_2 is still in phase I of expansion. In this case the expansion and the increased equality of s_1 are associated with an increase of the skew in the distribution of s_2 places.

Our first hypothesis is that promotion rates to post–form 4 schooling are less equal in Kenya than in Tanzania. The precondition of the model is satisfied; the gap in achievement between form 4 leavers with the most and the least educated parents is greater in Kenya than in Tanzania. Table 10-6 indicates that the proportion of Kenyan form 4 leavers in the two highest divisions of pass rises steeply with the educational level of their parents. In Tanzania no such relationship is observed. The smaller lower secondary system in Tanzania appears to be "creaming" the very highest

Table 10-6. *Percentage Distribution of Performance on Form 4 Examination, by Family Background*

Division of pass	*Kenya*				*Tanzania*			
	F_1	F_2	F_3	F_4	F_1	F_2	F_3	F_4
D_1	6.5	14.9	16.2	30.2	10.8	10.6	9.4	9.4
D_2	21.1	21.6	27.0	30.2	33.7	36.5	37.5	35.8
D_3	37.2	32.8	31.1	24.5	27.7	36.5	31.3	41.5
D_4	25.4	21.6	17.6	13.2	21.7	10.6	16.7	13.2
D_5	9.7	8.9	8.2	1.9	6.0	5.9	5.2	0.0

Note: D_1, division 1; D_2, division 2; D_3, division 3; D_4, division 4; D_5, failed or did not sit for examination; F_1, parents with no education; F_2, one parent with no education and one with primary education; F_3, both parents with primary education and one with secondary or higher education and one with none; F_4, one parent with primary education and one with secondary or higher education or both with secondary or higher education.

achievers among the children of the relatively uneducated, who then compete on equal terms with the children of the more educated. Since the Kenyan lower secondary system, because of its larger size, apparently does not "cream" to the same extent, children from relatively uneducated backgrounds tend to perform relatively poorly on the school-leaving examinations. In the model a decline in the achievement of the children of the uneducated as s_1 expands results in a decline in their promotion rate, $\pi_{s_2 f_u}$.

Partly because of the greater demand as a result of the faster expansion of lower secondary education in Kenya, upper secondary and higher education expanded at a faster pace there than in Tanzania. Enrollment in post–form 4 increased in Kenya from less than 0.1 percent to 1.5 percent between 1961 and 1975; in Tanzania the increase from a similar base was less than half as large. In the model expansion of s_2 from a very small base leads to an increase in the promotion rate of the children of the educated, $\pi_{s_2 f_e}$. Therefore we would expect $\pi_{s_2 f_e} - \pi_{s_2 f_u}$ to be greater in Kenya than in Tanzania.

Table 10-7 presents estimates of probit functions for upper secondary education. The dependent variable, Y_{is_2}, takes the value 1 if the individual attended upper secondary school and 0 otherwise. But since the equations are estimated only for respondents who attended form 4, they predict promotion rates (π_i) rather than the probabilities of attendance (P_i) predicted by the probit functions for primary and lower secondary education. The predicted promotion rates, by family background and over time, are also presented in the table. The macro constraint variable is again P_{s_1}, the aggregate probability of attending form 1 when the individual was 14 years old.

In Kenya the coefficients on the family background variables are large and highly significant and increase monotonically with parents' educational level. By contrast, Tanzania shows the same monotonic pattern, but the coefficients are smaller and not significant. The country differences in predicted rates of promotion are as hypothesized. The gap in promotion rates between the children of the most and the least educated is much greater in Kenya than in Tanzania. In Kenya a form 4 leaver who has a parent with secondary education is 7.0 times as likely to attend post–form 4 schooling as a form 4 leaver with uneducated parents; in Tanzania a child of the most educated parents is only 1.6 times as likely to attend as one with uneducated parents. In Tanzania post–form 4 expansion has been so slow that the rate of promotion declined between 1961 and 1975 for form 4 leavers irrespective of their family background, and the rate of decline has been much the same for all socioeconomic groups. In Kenya the predicted promotion rate has declined for form 4 leavers with uneducated parents but has increased for those with a parent with secondary education.

Is the distribution of post–form 4 schooling more unequal in Kenya than in Tanzania because of the faster expansion of upper secondary and higher education in Kenya? Has the distribution worsened over time in Kenya as a result of expansion from a small base? If, as seems likely, Kenya is still in phase I, the expansion of s_2 will have benefited primarily the children of the educated. We use $P_{s_2F_4} - P_{s_2F_1}$ as our measure of inequality. The percentages of groups F_1, F_2, F_3, and F_4 who go beyond form 4 in Kenya are 2.0, 9.0, 15.0, and 43.2, respectively; in Tanzania for the same groups they are 4.4, 7.1, 12.7, and 26.2, which implies a more equal distribution. To assess changes over time in Kenya we divide the sample into those aged 24 and younger and those aged 25 and older. Of those 25 or older, the percentages going beyond form 4 are 2.1, 7.7, 14.8, and 40.8 for F_1, F_2, F_3, and F_4. For those 24 or younger the corresponding percentages are 1.5, 12.9, 15.6, and 46.9. As predicted, it appears that the distribution of post–form 4 education is more skewed in Kenya than in Tanzania and has become somewhat more unequal over time in Kenya; the children of the educated are remaining one step ahead in educational attainment.

Conclusions

Our econometric analysis of the natural experiment in Kenya and Tanzania points to several conclusions about the relationship between educational policy, the distribution of schooling, and intergenerational mobility. A small secondary system will tend to be monopolized by children from relatively privileged backgrounds, as was the case in Kenya and Tanzania in the 1960s. Rapid expansion of that system, as in Kenya, will benefit disproportionately children from less privileged backgrounds without displacing children from more privileged backgrounds. A move to more meritocratic selection criteria, as in Tanzania, is not an effective substitute for expansion as a means of equalizing the distribution of secondary schooling. Children from more privileged backgrounds benefit from the greater out-of-school investments in human capital and from higher-quality primary schooling, which lead to greater skill acquisition in primary school and superior performance on standardized secondary entrance examinations.

Our analysis of lower secondary and post–form 4 education suggests generalizations about the effect of secondary expansion on access to tertiary education. Kenya's experience demonstrates that despite more equal representation in the pool of candidates for further education, greater equality in the distribution of secondary places does not necessarily bring about greater equality in the distribution of places at the next level. Secondary expansion entails a lowering of entry criteria. As a corollary, the performance on standardized examinations of children from less priv-

Table 10-7. *Probit Functions and Predicted Promotion Rates into Upper Secondary School, by Family Background*

		Probit coefficient			*Predicted probability*			
Item	*Mean*	*(1)*	*(2)*	*Year*	F_1	F_2	F_3	F_4
Kenya (511 cases)								
P_{s_1}	11.62	0.003	−0.035	1960	0.12	0.11	0.24	0.33
F_2	0.262	0.472**	−0.161	1965	0.08	0.14	0.24	0.39
F_3	0.283	0.726***	0.393	1970	0.05	0.18	0.24	0.47
F_4	0.333	1.274***	0.623	1977	0.03	0.23	0.24	0.55
B	0.082	0.143	0.140	Average	0.06	0.16	0.24	0.42
T	0.050	0.660**	0.723**					
$P_{s_1}F_2$	—	—	0.059*					
$P_{s_1}F_3$	—	—	0.035					
$P_{s_1}F_4$	—	—	0.062					
Constant	—	−1.532***	−1.171***					
χ^2	—	56.09	59.78					

Item	Mean	Probit coefficient		Year	Predicted probability			
		(1)	*(2)*		F_1	F_2	F_3	F_4
Tanzania (348 cases)								
P_{s_1}	2.57	−0.208***	−0.088	1960	0.28	0.34	0.44	0.52
F_2	0.272	0.039	0.261	1965	0.23	0.24	0.26	0.36
F_3	0.293	0.112	0.680	1970	0.21	0.19	0.17	0.28
F_4	0.162	0.392	0.783	1975	0.20	0.17	0.16	0.25
B	0.034	−0.856	−0.913	Average	0.23	0.24	0.26	0.36
T	0.076	−0.376	−0.396					
$P_{s_1}F_2$	—	—	−0.091					
$P_{s_1}F_3$	—	—	−0.226					
$P_{s_1}F_4$	—	—	−0.153					
Constant	—	−0.154	−0.445					
χ^2	—	13.14	14.77					

— Not applicable.

* Significant at the 10 percent level.

** Significant at the 5 percent level.

***Significant at the 1 percent level.

Note: For definitions, see notes to tables 10-3 and 10-4. Column numbers identify different equation specifications.

ileged backgrounds tends to erode in relation to the performance of children from more privileged backgrounds. The relative rate of promotion into the tertiary system of children from less privileged backgrounds therefore declines as the secondary system expands. This tendency counterbalances greater equality in the composition of demand for tertiary schooling. The distribution of places in the tertiary system may become less equal because an expansion of the tertiary system from a very small base in response to the growth of demand will initially disproportionately benefit the more privileged children.

Increased inequality in the distribution of places in the tertiary system will tend to offset the effect on intergenerational mobility of the decrease in inequality in the secondary system. Our examination of intergenerational mobility points to the rather pessimistic conclusion that education policy need not have much impact on mobility. No matter what policy is adopted—short of actually establishing educational quotas for the various family background groups and thereby possibly sacrificing allocative efficiency—there will be a strong tendency for the elite to perpetuate their relative position in the socioeconomic hierarchy.

But relativity is not everything. Although the expansion of secondary education in Kenya has not had the beneficial impact on intergenerational mobility that might have been expected, the *absolute* wages of those from less educated households are much higher in Kenya, partly because of the productivity gains from the expansion of the education system. There may also be direct consumption benefits from a higher level of education. Furthermore, the parents of most students in these countries have had no formal education, which makes it virtually impossible for them to contribute to their children's acquisition of academic skills. The advantages in school performance that children from more privileged backgrounds gain from the higher educational level of their parents may diminish as the educational level of the population as a whole increases.

Notes

1. For a discussion of some theoretical and empirical issues concerning educational production functions see Hanushek (1979) and Lau (1979).

2. Differences among individuals in human capital acquired before s_1 can affect PV_{is_1}. Increased human capital increases both the benefits and the opportunity cost (in earnings forgone) of s_1. These influences raise and lower PV_{is_1}, respectively. We assume that the first influence dominates.

3. The form of the educational production function implies that out-of-school investments are complementary to formal schooling. For supporting evidence for Kenya and Tanzania, see chapter 4.

4. If subsidies and restrictions on supply are sufficiently marked, virtually all s_0 leavers, irrespective of family background, will demand s_1. This would be the case, for instance, were point d to signify $PV_{is_1} = 0$.

5. When the market for s_1 is unconstrained, $\pi_{is_1} = 1$ (all i).

6. Note that when the estimated equation is used to predict probabilities, interactions between family background and aggregate enrollment manifest themselves even in the absence of multiplicative terms. In contrast to a simple linear probability equation, in the probit equation a marginal change in probability associated with a given variable depends on the values of the other exogenous variables:

$$\frac{\partial \operatorname{Prob}(Y = 1)}{\partial X_k} = B_k f(X'\beta)$$

where $f(X'\beta)$ is the value of the normal density function at the point $X'\beta$. The multiplicative variables are included to capture additional interactions.

7. The probability that $Y = 1$ is the area under the standard normal curve between $-\infty$ and $X'\beta$. In table 10-3 probabilities are predicted for Africans born outside Nairobi; that is, we set U and T equal to 0 and P_{s_0} equal to its actual value in the respective years.

8. The predicted probabilities are derived from the interactive equation in both instances because four of the six interaction terms are significant at least at the 10 percent level.

9. Conlisk (1974) has shown that reducing the random components in determination of economic success may actually strengthen systematic parent-child connections.

10. If all observations in each cell (i, j) are drawn independently and if all families face the same matrix of transition probabilities, the observed relative frequencies (F_{ij}) of children in each class for each parental class are binomially distributed about the true probabilities.

11. To obtain M_{pm} we construct a transition matrix in which the rows are identical and calculate the value of the index. For M_{lm} we construct a transition matrix that represents the situation of least mobility as follows. We fill in the unskilled category with children from the bottom parental category, F_1. Since the bottom parental category is larger than the unskilled category, we fill the next lowest occupational category with F_1 children. After the bottom two occupational categories have been filled with F_1 children, a few remain to go into the skilled manual category. The remainder of the skilled manual category is filled with F_2 children. The F_2 children left over after the skilled manual category is filled are put into the clerical category, and so on. We use this constructed matrix to calculate M_{lm}.

12. M^* is derived from M_{lm} (1.067 in Kenya and 0.983 in Tanzania) and M_{pm} (1.513 and 1.470, respectively).

13. Similarly, in an unconstrained system the achievement level on completion of s_0 necessary for demand to be positive is a positive function of the private cost of s_1 and is hence a negative function of the size of s_1.

CHAPTER 11

Educational Expansion, Family Background, and Earnings

CHAPTER 10 SHOWED, rather surprisingly, that despite Kenya's much larger secondary system and the consequent greater equality in the distribution of secondary education, intergenerational mobility is not greater there than in Tanzania. One reason for this phenomenon is the tendency for the children of the educated elite to remain one rung higher on the educational ladder. The proportion of children of the educated who continue beyond lower secondary school is larger than that of children of the uneducated, and in Kenya the difference between the two proportions is larger than in Tanzania.

Another possible reason for this outcome is differential labor market performance by family background for a given educational level. In Tanzania, among workers whose education ended at the lower secondary level, there are no systematic wage differentials among family background groups. In Kenya, by contrast, mean wages for form 4 leavers increase with the educational level of the worker's parents. The difference may be attributable to greater discrimination in the labor market on the basis of family background in Kenya—because of less egalitarian political rhetoric and attitudes or as a response by elite groups to the democratization of access to lower secondary schooling. Kenyan secondary leavers with educated parents may also be at an advantage in the labor market because they tend to acquire more human capital prior to secondary school and to attend better schools. This phenomenon may not be as evident in Tanzania, where the lower secondary system is smaller and more uniform.

We begin our empirical analysis by comparing the extent of discrimination by family background in the two countries. The conventional method of measuring discrimination is to calculate the income differential among the groups in question after standardizing for such proxies for human capital endowments as years of education and employment experience. The years-of-schooling variable will be an inadequate proxy for human capital acquired in school if performance in school differs by family background, as may be the case in Kenya. There may therefore be a systematic upward bias in conventional estimates of discrimination.

Consider the simplest regression model. Within an educational stratum the wage is a function of human capital endowment, C_i, and of some effect of family background, F, that is felt through discrimination in the labor market.

$$W = \alpha + b_1F + b_2C$$

Because human capital endowments are not observed, the regression model generally estimated is $W = \alpha + b_1F$. The omission of an explanatory variable causes the estimates of the coefficients to be biased unless the omitted variable is orthogonal to all the other variables in the model. In this example, if, as is most likely, $b_2 > 0$ and human capital endowments are positively correlated with family background, the coefficient on the latter variable will be overestimated.

It can be shown that the bias becomes larger as the correlation between family background and human capital increases and as the sample variation in the excluded human capital variable becomes larger (see Hanushek and Jackson 1977). In the general case with several exogenous variables such as years of work experience, this result holds if all the sample correlations have the same sign. The simple model in the next section shows that Kenya, with its larger education system, is likely to exhibit both a higher variation in human capital endowments within a given educational group and a higher correlation between family background and human capital. Hence the upward bias of the family background coefficient is likely to be larger for Kenya than for Tanzania. In this chapter we attempt to measure the extent of upward bias in estimates of discrimination by family background.

The Model

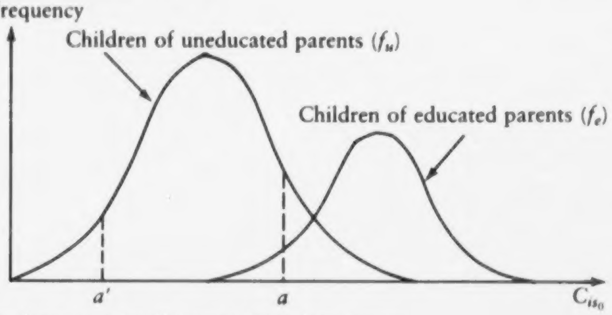
The model developed here is a variant of the one in chapter 10. We posit an educational production function:

$$C_{ij} = f(R_i, I_i, Q_i) \tag{11-1}$$

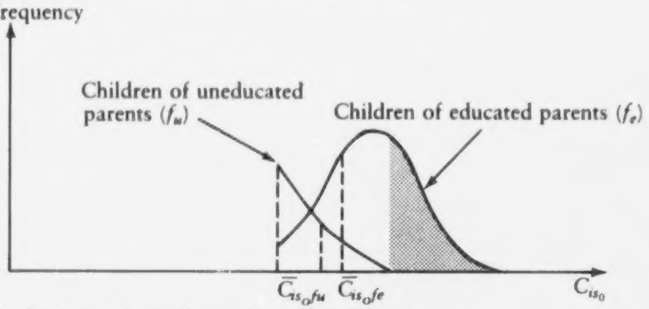
The human capital endowment of individual i at the conclusion of schooling level j, C_{ij}, is some (probably complex) positive function of natural ability, R_i; the quantity and quality of training provided in the home, I_i; and the quality of schooling, Q_i. Parents' education is a proxy for the quality of parental inputs.[1] To facilitate the exposition we divide parents into two groups, educated and uneducated. Figure 11-1 is a stylized simplification of the true situation, in which there is more variation in the

Figure 11-1. *The Distribution of Human Capital, by Family Background*

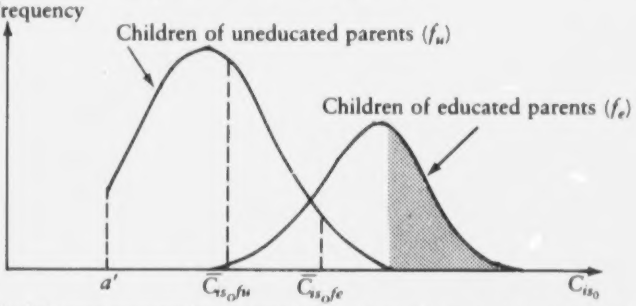
A. Primary School Leavers



B. Students in a Small Lower Secondary System



C. Students in a Large Lower Secondary System



Note: Shaded areas represent lower secondary students who go on to upper secondary school.

parental quality variable. Panel A depicts the distributions by human capital endowment of primary leavers with educated parents, f_e, and with uneducated parents, f_u. The distributions reflect our presumptions that natural ability is distributed normally and that educated parents are the smaller group. The distribution of primary leavers with educated parents lies to the right of the distribution of those with uneducated parents. We assume that, as was discussed in chapter 10, educated parents make larger out-of-school investments in their children and send their children to higher-quality schools.[2] Educated parents may have higher natural ability, which their children may inherit. This difference in ability may be attributable to the selectivity of the school system and to assortative mating, the tendency for relatively highly educated (high-ability) men to marry relatively highly educated (high-ability) women.

We assume that, because of large government subsidies to secondary education and the consequent high private returns, there is excess demand for secondary places. Under meritocratic selection criteria, primary leavers must have a higher level of endowments—as measured, for example, by primary-leaving examinations—to gain access to a small secondary system than to a large system. Panel B depicts the family background composition for a small lower secondary system, and panel C shows the composition for a large system. The variance of endowments is much higher in the large than in the small system. Moreover, because only the upper tail of the distribution of children of uneducated parents gains access in a small system, there is little difference in the mean level of endowments between children of educated and uneducated parents. In a large system the gap between family background groups in the mean level of endowments is also large.

Unless there is some marked change in relative inputs or in production functions, relative endowments of human capital on entry to lower secondary school are likely to prove good predictors of relative endowments on completion. Under this assumption panels B and C show the mean values of endowments of those form 4 leavers with educated and with uneducated parents who do not gain access to upper secondary school and who therefore enter the labor market. The shaded areas in panels B and C represent lower secondary leavers who progress to upper secondary school. In a small system (panel B) mean human capital endowments are roughly the same for all form 4 leavers entering the labor market, whether their parents are educated or uneducated. Expanding the secondary system substantially lowers the endowments of entrants with uneducated parents in comparison with entrants with educated parents.

What are the labor market implications of these changes in the market for education? We assume that the following function describes how wages are determined:

$$W_i = f(C_i, L_i, F_i) \tag{11-2}$$

This general function is in the spirit of Mincer's human capital wage function (Mincer 1974). An important difference is that our measure of the output of the education system, C_i, replaces years of schooling—an input into the production function[1]—as an independent variable. Postschool acquisition of skills is represented in the conventional way by L_i, the individual's years of employment experience, and family background is represented by F_{ij}, parents' education. In contrast to Mincer's function, our function, when stratified by education, permits variance in human capital and hence in wages among workers with a given level of experience.

The labor market implications of educational expansion are represented by the following set of linkages:

$$\frac{\partial z_u/z_e}{\partial z} > 0; \quad \frac{\partial C_e/C_u}{\partial z_u/z_e} > 0; \quad \frac{\partial W_e/W_u}{\partial C_e/C_u} > 0; \quad \frac{\partial W_e/W_u}{\partial z} > 0 \tag{11-3}$$

where z denotes the supply of form 4 leavers and e and u denote educated or uneducated parents. The first linkage indicates that an increase in the supply of form 4 leavers as a result of expansion of the secondary system increases the proportion of form 4 leavers with uneducated parents in the labor force. The second linkage indicates that as this proportion increases so does the ratio between the average human capital endowment of form 4 leavers with educated parents and that of form 4 leavers with uneducated parents. Underlying the third linkage is the assumption that the demand for and supply of efficiency units of labor, rather than of actual units, determine wages. Profit-maximizing employers seek to minimize the cost per efficiency unit of labor rather than the cost per worker. Thus, if we standardize employment experience, in equilibrium the ratio of wages is equal to the ratio of human capital endowments. As C_e/C_u increases, so does W_e/W_u.

The interaction between the education and labor markets is summarized by the fourth linkage. An increase in the supply of form 4 leavers as a result of educational expansion induces the emergence of a wage gap between form 4 leavers with educated and uneducated parents. The elasticity of the wage gap with respect to a given increase in supply depends on the differences between family background groups in the quality of schooling, in the quantity and quality of out-of-school investments in human capital, and in ability; the relative sizes of the groups; and the initial size of the secondary system.

Family Background and Earnings: Discrimination or Unmeasured Human Capital?

A feature of the survey not previously mentioned is that respondents were questioned about their performance on the national examinations administered at the conclusion of form 4 in both countries. These scores provide a measure of the output of the lower secondary system that permits us to estimate the specification of the human capital wage function (equation 11-2) that is most appropriate for form 4 leavers.

Conventional Measures of Discrimination

The family background structure of mean wages of form 4 leavers is presented in table 11-1. In Tanzania there is no discernible relationship between wages and family background. In Kenya the wages of form 4 leavers with educated parents are higher than the wages of those with both parents uneducated; the difference is 14 percent for the F_3 group and 17 percent for the F_4 group.

Table 11-1. *Conventional Measures of Discrimination, by Family Background*

	Kenya		*Tanzania*	
Item	*Shillings per month*	*Index*	*Shillings per month*	*Index*
A. Mean earnings of form 4 leavers				
F_1	1,550	100	1,235	100
F_2	1,485	96	1,198	97
F_3	1,767	114	1,265	102
F_4	1,815	117	1,219	99
B. Predicted earnings of form 4 leavers with ten years of employment experience[a]				
F_1	1,556	100	1,480	100
F_2	1,604	103	1,313	89
F_3	1,737	112	1,495	101
F_4	2,298	148	1,525	103
C. Gross wage difference between high and low family background groups				
$(\overline{W}_e - \overline{W}_u)$[b]	259		30	

Notes: F_1, both parents with no education; F_2, one parent with primary education and one with none; F_3, both parents with secondary education; F_4, both parents with secondary education or one with primary education and one with secondary education.

a. Predicted from equation 1, table 11-2.

b. Calculated with the use of equation 2, table 11-2.

Columns 1 and 2 of table 11-2 present estimates of the following function for form 4 leavers:

$$\ln W = a + bL + cL^2 + dF_j \tag{11-4}$$

This function permits us to standardize the family background structure of wages for differences in employment experience among family background groups. In Tanzania the coefficients on F_j are small and statistically insignificant, confirming the absence of a wage premium for form 4 leavers with educated parents. In Kenya, by contrast, the coefficients on F_3 and F_4 are significant and the latter is large.

The regressions in table 11-2 are used in table 11-1 to predict the wages of form 4 leavers with ten years of employment experience but with different family backgrounds. A comparison of mean earnings of all form 4 leavers with the predicted earnings of those with ten years of experience indicates almost no change in Tanzania. In Kenya the index for F_4 rises from 117 to 148 because form 4 leavers with uneducated parents have more employment experience than the form 4 leavers whose parents have the most education. The latter group is younger, reflecting the rarity, until recently, of marriages in which both spouses have relatively high educational levels.

We take the analysis of discrimination a step further and allow for differences among family background groups in the structure of wages. The standard technique for measuring discrimination when two groups differ in their personal characteristics and in the function relating these characteristics to wages is to compare their actual mean wages with what their mean wages would be if all were paid according to the same wage function—that is, with the same constant term and the same set of coefficients on the independent variables.[4] Columns 3 and 5 of table 11-2 present estimates of equation 11-4 disaggregated into two groups by family background. These equations are used to decompose the gross wage difference, $G = \overline{W}_e - \overline{W}_u$, between form 4 leavers in the two family background groups. The difference is 259 shillings in Kenya and a negligible 30 shillings in Tanzania.

The gross wage difference is made up of the part explained by personal characteristics and the unexplained part that reflects differences in the constant terms and coefficients of the regression equations for the educated and uneducated groups. Let **X** be a vector of the personal characteristics L and L^2. Then

$$G = \overline{W}_e - \overline{W}_u = \overline{W}_e - f_e(\overline{\mathbf{X}}_u) + f_e(\overline{\mathbf{X}}_u) - \overline{W}_u = E + R \tag{11-5}$$

respectively, where E is the explained and R the unexplained residual part of G. In Kenya 16 percent of G is explained by the difference in employment experience; fully 84 percent of the gross difference is not explained and would therefore be conventionally attributed to discrimi-

Table 11-2. *Estimated Wage Functions for Form 4 Leavers*

Country and variable	*All form 4 leavers* (1)	(2)	*Family background groups F_u* (3)	(4)	*Family background groups F_e* (5)	(6)
Kenya						
L	0.111	0.103	0.116	0.106	0.108	0.103
	(10.79)	(10.64)	(9.02)	(8.83)	(5.87)	(6.18)
L^2	−0.002	−0.002	−0.002	−0.002	−0.002	−0.002
	(5.27)	(5.00)	(4.34)	(4.29)	(2.92)	(2.77)
F_2	0.028	−0.012	—	—	—	—
	(0.46)	(0.22)	—	—	—	—
F_3	0.109	0.070	—	—	—	—
	(1.80)	(1.24)	—	—	—	—
F_4	0.385	0.336	—	—	—	—
	(3.34)	(3.14)	—	—	—	—
D_1	—	0.792	—	0.743	—	0.899
	—	(6.25)	—	(6.45)	—	(4.53)
D_2	—	0.421	—	0.431	—	0.426
	—	(5.39)	—	(4.45)	—	(3.14)
D_3	—	0.197	—	0.190	—	0.240
	—	(2.80)	—	(2.19)	—	(1.95)
D_4	—	−0.004	—	−0.070	—	−0.135
	—	(0.00)	—	(0.77)	—	(0.97)
Constant	6.439	6.314	6.443	6.282	6.600	6.413
$\bar{R}^2$	0.343	0.439	0.340	0.413	0.297	0.447
N	426	425	284	284	142	141
F	45.48	37.81	74.04	34.14	30.84	19.85

Tanzania						
L	0.118	0.111	0.113	0.111	0.123	0.113
	(9.55)	(9.30)	(7.02)	(7.08)	(6.38)	(5.96)
L^2	−0.002	−0.002	−0.0022	−0.002	−0.003	−0.003
	(4.94)	(5.04)	(3.54)	(3.70)	(3.42)	(3.36)
F_2	−0.124	−0.128	—	—	—	—
	(1.67)	(1.78)	—	—	—	—
F_3	0.008	0.008	—	—	—	—
	(0.10)	(0.10)	—	—	—	—
F_4	0.033	0.031	—	—	—	—
	(0.36)	(0.35)	—	—	—	—
D_1	—	0.411	—	0.305	—	0.488
	—	(2.54)	—	(1.35)	—	(2.04)
D_2	—	0.240	—	0.250	—	0.256
	—	(2.91)	—	(2.38)	—	(1.85)
D_3	—	0.046	—	0.011	—	0.081
	—	(0.63)	—	(0.10)	—	(0.73)
D_4	—	−0.175	—	−0.134	—	−0.185
	—	(2.04)	—	(1.19)	—	(1.40)
Constant	6.315	6.309	6.269	6.235	6.315	6.315
$\bar{R}^2$	0.407	0.468	0.412	0.473	0.393	0.439
N	264	262	146	145	117	117
F	37.09	26.51	52.08	22.55	38.51	16.15

— Not applicable.

Notes: The figures in parentheses are *t*-statistics. Column numbers identify different regression specifications. F_u, children of uneducated parents; F_e, children of educated parents; F_2, one parent with primary education and one with none; F_3, both parents with secondary education; F_4, both parents with secondary education or one with primary education and one with secondary education (for the F variables the base category is F_1, both parents with no education); L, years of employment experience; D_1, division 1 on form 4 examination; D_2, division 2; D_3, division 3; D_4, division 4 (D_5, failed or did not sit the examination, is the base category).

nation.[5] In Tanzania the gross difference is small and the decomposition has little meaning.

Educational Expansion and Labor Market Differentiation: The Linkages

In this section we discuss whether the marked difference between Kenya and Tanzania in the structure of wages of form 4 leavers by family background can be explained other than by discrimination. We first examine empirically the linkages summarized in equation 11-3. We then determine how much our measure of discrimination in Kenya is reduced by taking account of the differences in cognitive achievement among family background groups of form 4 leavers.

The first linkage in equation 11-3 is

$$\frac{\partial z_u/z_e}{\partial z} > 0$$

Although Kenya and Tanzania have similar primary and tertiary enrollment rates, Kenya has a markedly higher secondary enrollment rate. The difference is reflected in the educational composition of the urban wage labor force of the two countries. The proportion of the urban wage labor force with lower secondary education is 50 percent greater in Kenya than in Tanzania. The model's first linkage predicts that the distribution by family background of secondary places will be more equal in Kenya than in Tanzania and that the composition according to family background of secondary leavers in the wage labor force will become more representative of the family background composition of the population.

Table 11-3 confirms these predictions. Part A presents estimates of the probability of attending secondary school for children in each family background group as predicted by probit educational attainment functions with precisely the same specification in each country.[6] The average probability that a child of the most educated parents will attend secondary school is very high—0.85 in Kenya and 0.82 in Tanzania. Although the predicted probability for a child of uneducated parents is much lower in both countries, in Tanzania, at 0.16, it is less than half the probability in Kenya, 0.36. The distribution of secondary opportunities is thus more equal in Kenya than in Tanzania. Part B indicates that among form 4 leavers in the wage labor force a markedly higher proportion is from uneducated backgrounds in Kenya than in Tanzania.

The second linkage is

$$\frac{\partial C_e/C_u}{\partial z_u/z_e} > 0$$

Table 11-3. *Secondary Attenders and Completers, by Family Background*

Item	*Kenya*	*Tanzania*
A. Predicted probability of attending secondary school[a]		
F_1	0.36	0.16
F_2	0.50	0.35
F_3	0.69	0.48
F_4	0.85	0.82
B. Family background composition of secondary (form 4) completers (percent)		
F_1	38.8	22.9
F_2	25.7	28.2
F_3	23.4	27.6
F_4	12.2	21.3

Note: For definitions of variables, see note to table 11-2.

a. Predicted from probit educational attainment functions, chapter 10.

Part A of table 11-4 presents data from chapter 10 in the form of a cross-tabulation of family background and aggregate scores on the form 4 examinations, with division 1 (D_1) representing the highest and division 5 (D_5) the lowest scores. In Tanzania there is no discernible relationship between examination performance and family background. The small secondary system in Tanzania appears to be "creaming" the highest achievers among children of relatively uneducated parents, and they then compete on equal terms with children of more educated parents. In Kenya, by contrast, the proportion of form 4 leavers in the two highest divisions rises steeply with parents' educational level. The comparison of Kenya and Tanzania confirms the prediction that as the secondary system expands and draws in more children from relatively low socioeconomic backgrounds, a gap in cognitive skill will emerge between family background groups. The relationship between examination score and family background is, however, much weaker for the group on which our analysis is focused—those who leave education at the end of form 4 and enter wage employment (part B)—than among all form 4 leavers, including those who continue their education beyond form 4 (part A). This is because upper secondary schooling is highly selective of the highest scorers among form 4 leavers.

To evaluate the third linkage

$$\frac{\partial W_e/W_u}{\partial C_e/C_u} > 0$$

Table 11-4. *Percentage Distribution of Performance on Form 4 Examination, by Family Background*

	Kenya					*Tanzania*				
Group	D_1	D_2	D_3	D_4	D_5	D_1	D_2	D_3	D_4	D_5
A. Form 4 leavers										
F_1	6.5	21.1	37.3	25.4	9.7	10.8	33.7	27.7	21.7	6.0
F_2	14.9	21.6	32.8	21.6	8.9	10.6	36.5	36.5	10.6	5.9
F_3	16.2	27.0	31.1	17.6	8.2	9.4	37.5	31.3	16.7	5.2
F_4	30.2	30.2	24.5	13.2	1.9	9.4	35.8	41.5	13.2	0.0
B. Form 4 attenders										
F_1	2.3	24.0	40.6	24.6	8.6	1.5	30.8	32.3	27.7	7.7
F_2	7.2	21.2	42.0	22.3	7.2	4.8	25.4	47.6	14.3	7.9
F_3	7.0	24.7	38.5	18.4	11.4	4.3	28.6	37.1	22.9	7.1
F_4	5.0	16.9	46.6	25.9	4.6	5.6	16.7	58.3	19.4	0.0

Note: For definitions of variables, see note to table 11-2.

we modify our wage function, equation 11-4, as follows:

$$\ln W = a + bL + cL^2 + dF_i + eD_i \qquad (11\text{-}6)$$

where D_i is a vector of examination scores with "failed" or "did not sit" (D_5) as the base. This function allows us to measure the structure by family background of the wages of form 4 leavers, with performance on form 4 examinations standardized. We expect eD_i to be positive and significant; that is, as human capital theory predicts, differences among form 4 leavers in human capital endowments, as measured by examination scores, will be reflected in the structure of wages.

Table 11-2 presents estimated wage functions for Kenya and Tanzania by family background. In both countries the fit of the function as measured by R_2 is somewhat improved when examination performance is added to the equation (compare columns 1 and 2). In both countries the coefficients on the D variables increase monotonically with examination score, except for the coefficient on D_4, which is small. The coefficients on D_1 and D_2, the highest divisions, are positive, large, and highly significant. Table 11-5 indicates that the predicted wages of a representative form 4 leaver are 121 percent higher in Kenya and 51 percent higher in Tanzania if the person was placed in division 1 rather than in division 5. Note the consistency of these findings with those in chapter 3.

How large is the bias in the measurement of discrimination that arises when differences in endowments among family background groups are ignored? Table 11-2 shows that in Tanzania the coefficients on the F variables are not altered by the inclusion of examination performance; these coefficients remain small and insignificant. In Kenya, by contrast, the co-

Table 11-5. *Predicted Standardized Earnings of Form 4 Leavers with Ten Years of Employment Experience, by Performance on Form 4 Examination*

Division of pass	*Kenya*		*Tanzania*	
	Shillings per month	*Index*	*Shillings per month*	*Index*
D_1	3,413	221	2,391	151
D_2	2,355	152	2,015	127
D_3	1,882	122	1,659	105
D_4	1,540	100	1,330	84
D_5	1,546	100	1,585	100

Note: Earnings are predicted from equation 2, table 11-2, standardizing at the mean of independent variables other than D_i. For definitions of variables, see note to table 11-2.

efficients on F_3 and F_4 are smaller and less significant when examination performance is included. (The coefficient on F_3 in column 2 is actually statistically insignificant.) We predicted the wages of form 4 leavers by family background, with performance on form 4 examinations standardized. Part A of table 11-6 presents the results of these simulations. A comparison with the predicted wages in part B of table 11-1 indicates no change in Tanzania. In Kenya the wage premium earned by the F_3 group falls from 12 to 7 percent, and the premium earned by the F_4 group falls from 148 to 140 percent.

By using table 11-2 (columns 4 and 6), it is possible to take account of examination performance in the decomposition of the gross wage difference ($\overline{W}_e - \overline{W}_u$). In Kenya 16 percent of G is explained by the difference in employment experience, 22 percent is explained by differences in examination performance, and the residual attributable to discrimination is reduced from 84 to 62 percent.

The impact of differences in cognitive skill on our measure of discrimination by family background would be substantially larger if all form 4 examination takers terminated their education at that stage. The fact that many of the highest achievers on form 4 examinations continue their education weakens the relationship between examination performance and family background among form 4 leavers. Part B of table 11-6 shows what the wages of the different family background groups would have been had all form 4 attenders left at that stage. We substituted examination performance for all form 4 attenders (part A of table 11-4) into the regression for form 4 leavers in column 2 of table 11-2, with the family background dummies set at zero, and derived predicted wages. Differences in examination performance alone (that is, without the effects of discrimination) yield a 22 percent difference between the highest and the lowest family background groups.

Table 11-6. *Predicted Earnings, by Family Background*

	Kenya		*Tanzania*	
Item	*Shillings per month*	*Index*	*Shillings per month*	*Index*
A. Predicted earnings of form 4 leavers with ten years of employment experience[a]				
F_1	1,575	100	1,450	100
F_2	1,556	99	1,275	88
F_3	1,689	107	1,461	101
F_4	2,203	140	1,495	103
B. Predicted earnings of form 4 attenders with ten years of employment experience				
F_1	1,644	100	...	...
F_2	1,758	107	...	...
F_3	1,806	110	...	...
F_4	2,013	122	...	...

... Not calculated.

Note: For definitions of variables, see note to table 11-2.

a. All groups are simulated to have mean performance on form 4 examinations.

Conclusions

We confirmed that in Kenya, for those who left school on completing form 4, there is a strong positive relationship between family background, as measured by parents' education, and labor market performance, as measured by the wage. This relationship helps to explain why there is no more intergenerational mobility in Kenya than in Tanzania. Both of our hypotheses concerning this outcome were borne out: there is greater discrimination by family background in Kenya than in Tanzania, and there is greater differentiation by performance in school. The former phenomenon seems to be the more important. It is clear that the greater expansion of enrollment in Kenya induced greater differentiation by performance in school. It is possible—but this is speculation—that educational expansion may also have generated the greater discrimination found in Kenya. Employers, faced with a larger pool of secondary leavers, may be using family background as a screening device.

A general methodological point also emerges from the analysis. To attempt to measure labor market discrimination while ignoring the interaction between the market for education and the market for labor carries a risk of error in the measurement of discrimination and its change over time. Rapid expansion of the education system may induce a widening of the gap in human capital endowments (as measured by academic performance) between groups from different family backgrounds. If the conventional specification of the human capital wage function is then used to standardize the gross wage difference between the groups for differences in endowments, the residual will overestimate wage discrimination. Years of schooling is too crude a proxy for economically productive skills acquired before entering employment. The variance in human capital endowments among children with the same years of schooling is large, and some of what appears to be discrimination actually reflects the poorer academic performance of the group that is most subject to discrimination. Including measures of academic performance in the wage function reduces the residual in Kenya by roughly a quarter, although a substantial amount of discrimination remains.

The results of this chapter should not mislead us into thinking that family background has little or no influence on returns to schooling. In appendix I we show that returns to schooling, where schooling is measured by a continuous variable, increase markedly with parents' education in both countries. The findings suggest that family background affects earnings because out-of-school investments in human capital by educated families complement school investments and enable the children to learn more in school and because children from educated families attend better schools. The results also suggest that the independent effects of human capital acquired out of school and of labor market discrimination are of less importance.

Notes

1. For empirical evidence that observed parental schooling is an imperfect proxy for parental influences on child development, see Behrman and others (1980) and Olneck (1977) for the United States and Behrman and Wolfe (1984a, 1984b) and Behrman and Wolfe (forthcoming) for Nicaragua. In our sample, however, the parental generation consists almost entirely of very poor subsistence farmers. Thus such commonly used measures of family status as fathers' occupation or income are not useful, and parents' education seems the best indicator of differentiation among families.

2. Educated people generally live in areas where the quality of schooling is above average. The quality of schooling appears to be an important determinant of productivity. For example, in Brazil, Behrman and Birdsall (1983) estimated the social return to school quality, using teachers' education as an indicator of quality, and found it to be substantially higher than the social return to school quantity.

3. The wage function represented by equation 11-2 is stratified by educational level and therefore does not include years of education among the independent variables as would the aggregate version. In the empirical analysis C is measured by results on the form 4 examination.

4. See Blinder (1973), Brown, Moon, and Zoloth (1980), Malkiel and Malkiel

(1973), and Oaxaca (1973a, 1973b). For developing countries see Behrman and Wolfe (forthcoming), and Knight and Sabot (1982).

5. The corresponding decomposition in which the F_3, F_4 group is paid according to the F_1, F_2 wage structure yields essentially the same result.

6. The function is of the following general form: $\text{Prob}(Y = 1) = \Phi(\mathbf{X}'\beta)$, where Y is a dichotomous variable that takes the value 1 if the individual attended secondary school or 0 if he or she did not, **X** is a vector of exogenous variables, including family background, and $\Phi(\mathbf{X}'\beta)$ is the cumulative unit normal distribution function. The results are derived from the estimated equations presented in chapter 10.

Part V

THE COST-BENEFIT ANALYSIS OF SECONDARY EDUCATION: METHODOLOGICAL AND POLICY ISSUES

CHAPTER 12

The Returns to Cognitive Skill Acquired in School

MANY STUDIES HAVE BEEN CONDUCTED on the educational rate of return in both developed and developing countries. Psacharopoulos (1973, 1981) has compiled such estimates from forty-four countries. Although the quality of data and the sophistication of methods and interpretations vary, a fairly standard methodology has been employed, as noted in previous chapters. In chapter 3 we discussed a well-known criticism of the use of rates of return as a criterion for government policy on educational expansion. It has been argued that the generally observed positive relationship between educational level and earnings does not necessarily show the effect on productivity of human capital acquired in school. Rather, it could wholly or partially represent the influence on earnings of natural ability. Employers may reward the ability of individual workers, or they may use education as a statistical screening device for ability. Alternatively, the correlation may include an element of credentialism—that is, payments for education irrespective of its productive value, on account of social relationships or concepts of fairness. The standard methodology simply assumes away these possibilities.

This chapter presents a methodological innovation that takes empirical account of this criticism and that thus has important policy implications. We use the recursive model developed and estimated in chapter 3 to measure the rate of return on education by tracing the effect of schooling on cognitive skill and hence on earnings. The empirical analysis is based on the Kenyan subsample for which we have data on reasoning ability and cognitive skill. The analysis is confined to Kenya because the small size of our subsample prevents our taking account econometrically of the large impact that the Tanzanian government's pay policy has on the structure of earnings and the returns to education. In chapter 13 we focus on the complicating effect of pay policy on rates of return, using the full samples.

The secondary system in Kenya is competitive—access to subsidized places in government schools is based on examination performance—and

Table 12-1. *Decomposition of the Earnings Premium and of the Social Rate of Return to Secondary Education in Kenya*
(percent)

Source of estimate	*Increase in earnings*	*Social rate of return*
Standard equation	61	15
Recursive system, all effects	66	15
Ability	3	. . .
Credentialism	21	1
Cognitive skill	33	7
Cognitive skill and credentialism	61	14

. . . Negative rate; could not be calculated.

Notes: The percentage addition to earnings is based on posttax earnings data, which were used to estimate equations 12-1 through 12-4.

The social benefits of secondary schooling are based on the simulated streams of pretax earnings to primary and secondary completers. The primary completers are assumed to be in the labor force for forty years and the secondary completers for thirty-six years.

Only net-of-tax earnings data were obtained from employees, but data on pretax and posttax earnings for a subsample were collected from employers as a check. From these a quadratic relationship between pretax and posttax earnings was estimated and was then used to derive the pretax from the posttax stream.

The costs of secondary schooling used in estimating social rates of return are earnings forgone during the four years of schooling, direct private expenses, and government subsidies. Direct private cost per student is based on the reported expenditures by survey respondents on the education of their children in secondary school. The public subsidy per student is obtained from official figures of annual government expenditures on secondary education divided by total (government and private) secondary enrollment.

The average duration of job search (two years for primary completers and one year for secondary completers) was allowed for in estimating the net benefit stream.

A percentage rate of return reported as x indicates a value lying between x and $x + 1$.

years of schooling may provide good signals of ability. Moreover, institutional arrangements suggest that entry grades and pay in public sector employment are influenced by educational qualifications. Thus, although conventional estimates indicate that the rate of return to secondary education is high (see table 12-1), explanations of the earnings-education relationship in terms of ability, screening, or credentialism cannot be dismissed.

The Three-Equation System

Recall our three-equation recursive system:

$$S = a_0 + a_1R + a_2P + a_{3i}F_i + v \tag{12-1}$$

$$H = b_0 + b_1R + b_2S + b_3G + b_4B + y \tag{12-2}$$

$$(12\text{-}3) \qquad \ln W = c_0 + c_1 S + c_2 R + c_3 H + c_4 L + c_5 L^2 + z$$

Equation 12-1 reflects the effect of natural ability on educational attainment within a subsidized and competitive education system, as well as the influence of the size of the school system and of family background. Equation 12-2 is an educational production function in which cognitive achievement depends on reasoning ability, educational attainment, and proxies for quality of schooling. The earnings function specified in equation 12-3 includes the conventional variables, educational attainment and employment experience, and, in addition, our measures of reasoning ability and cognitive skill. The dependent variable is pretax earnings.

It is possible to interpret the coefficient on S in the earnings function as the effect of credentialism, the coefficient on R as the effect of natural ability independent of schooling, and the coefficient on H as the effect of human capital formation. Although the R and H variables represent a distinct advance in rate of return analysis, their possible limitations should be recalled in interpreting the results discussed below. If the reasoning score is too narrow a measure of natural ability and the cognitive skill score too narrow a measure of the productive traits acquired in school, the coefficients on R and H are likely to understate the importance of natural ability and human capital formation, and insofar as these omitted elements are positively correlated with educational attainment, the coefficient on S is likely to overstate the importance of credentialism.

The educational attainment function, which is based on equation 12-1, was estimated by means of probit analysis. It is reproduced from chapter 3:

$$(12\text{-}1') \quad \hat{p} = \Phi(\underset{(4.501)}{-1.816} + \underset{(3.075)}{0.049R} + \underset{(3.918)}{0.070P} + \underset{(0.752)}{0.184F_1} + \underset{(1.975)}{0.530F_2})$$

where $\chi^2 = 46.54$, $\hat{p}$ is the probability of going on to secondary school, $\Phi(\cdot)$ is the cumulative unit normal distribution, and the figures in parentheses are t-statistics. The probability of going on to secondary school is positively and significantly related to the ability score, to the secondary enrollment ratio, and to both parents' being educated.

The educational attainment function is relevant insofar as the secondary school system selects the more able and the more able acquire relatively more cognitive skill as a result of their secondary schooling. The significant positive coefficient on R provides a justification for regarding the difference in mean reasoning ability between secondary and primary leavers ($\bar{R}_s - \bar{R}_p = 30.3 - 25.7 = 4.6$) as a consequence of the selection process for secondary school. It will be used to indicate the contribution that the selection function of secondary schooling makes to human capital acquisition.[1]

The educational production function, from chapter 3, is as follows:

$$(12\text{-}2') \qquad H = 15.49 + \underset{(5.55)}{0.560R} + \underset{(8.50)}{11.745S} + \underset{(2.49)}{3.366G} - \underset{(1.78)}{3.567B}$$

where $\bar{R}^2 = 0.42$, the percentage standard error of $H = 21$, and the figures in parentheses are *t*-statistics.[2] Secondary education raises H by 11.75 points, or in the proportion 0.30 at the mean, and the elasticity of response of H to R is 0.40 at the mean. The educational production function shows that secondary schooling does indeed raise cognitive skill and that the selection function of secondary schooling, by choosing the more able, contributes to acquisition of cognitive skill. We present evidence below that the coefficient on S represents cognitive skill acquired in secondary education and not selection by secondary schools of primary leavers with higher levels of cognitive skill.

The earnings function was estimated to be

$$(12\text{-}3') \qquad \ln W = 5.459 + \underset{(2.47)}{0.192S} + \underset{(1.32)}{0.006R} + \underset{(6.18)}{0.020H} + \underset{(9.84)}{0.045L}$$

where $\bar{R}^2 = 0.44$ and the figures in parentheses are *t*-statistics. The L^2 term was dropped owing to its lack of statistical significance. Earnings are raised significantly by a unit increase in cognitive skill but not by a unit increase in reasoning ability. The product $b_2 \cdot c_3$ shows the effect on earnings of learning one's lessons in secondary school. The value of this product (0.23) indicates that when reasoning ability is held constant, cognitive skill acquired in secondary school raises earnings by 26 percent. The credentialist effect of secondary schooling on earnings is also significantly positive but smaller.

Simulating the Rate of Return to Acquisition of Human Capital

The earnings function used for the standard estimation of the rate of return on secondary schooling is of the form:

$$(12\text{-}4) \qquad \ln W = c'_0 + c'_1S + c'_4L + c'_5L^2 + z'$$

that is, equation 12-3 without the R and H terms. The net benefit streams of primary and of secondary leavers differ each year by the amount c'_1 (in natural logs) and by the earnings forgone and other costs incurred while attending secondary school. The annual difference, c'_1, is simply assumed to be the measure of human capital acquired in school.

The object of our simulation exercise is to use the three-equation system to decompose the annual difference in earnings as estimated above, c'_1, into three parts that correspond to the effects of credentialism, ability, and cognitive skill. The credentialist effect of secondary school attendance on annual earnings, when reasoning ability and cognitive skill are held constant, is given by c_1. Because those who attend secondary school are more able, their annual earnings are higher by the amount $c_2 (\bar{R}_s - \bar{R}_p)$. The contribution to annual earnings of cognitive skill acquired in school has two components, corresponding to the selection function and the educational function of secondary schooling: $c_3[b_1(\bar{R}_s - \bar{R}_p) + b_2]$. The sum of all three effects is given by the expression:

$$c_1 + c_2(\bar{R}_s - \bar{R}_p) + c_3[b_1(\bar{R}_s - \bar{R}_p) + b_2]$$

This term should correspond to c_1' in the standard method of estimating benefits, based on equation 12-4.

Table 12-1 shows estimates, from the standard equation and from the recursive system, of the percentage addition to annual earnings that is attributable to secondary schooling. When the recursive system is used, the increase in earnings attributable to all the separate effects combined is 66 percent, close to the prediction from the standard equation. This is also true if the standard equation, with S deleted, is estimated separately for primary and secondary leavers, which is equivalent to inserting interaction terms between S and the experience terms in equation 12-4. Ability accounts for very little of this total, credentialism for a third, and cognitive skill for no less than half. A combination of cognitive skill and credentialism accounts for almost all of the increase.

Table 12-1 also presents estimates of the social rate of return derived by following the standard methodology in every respect except the decomposition of benefits. On the standard definition of the benefit stream, the return is 13 percent. When the recursive system is used and all the effects are combined, it is 15 percent. The pattern of rates of return does not correspond to the pattern of increases in earnings, however, because rates of return have a different lower bound. Owing to the initial costs, a zero gross benefit involves an infinitely negative rate of return, and a small addition to earnings, such as that contributed by ability, involves a large negative rate. For similar reasons the rate of return attributable to credentialism is a mere 1 percent. Only cognitive skill produces a substantial positive return, 7 percent.

It would seem, therefore, that the return to secondary education through acquisition of cognitive skill is quite high but is little more than half that estimated according to the standard methodology. The combined effects of cognitive skill and credentialism, however, produce a return of no less than 14 percent. Much therefore depends on the interpretation placed on the coefficient of secondary school attendance in equation 12-1. We have so far assumed that it represents credentialism, but secondary school attendance could plausibly be acting as a proxy for acquisition of noncognitive human capital in secondary school. In that case our credentialism effect would, in whole or in part, represent human capital formation. Our estimated return from cognitive skill provides a lower bound on the return on human capital acquired in secondary school, that is, on the social rate of return.

Conclusions

The purpose of this chapter has not been to unveil the "true" rate of return to expenditure on secondary education in Kenya. Instead, the intention has been to make a methodological contribution by taking quantitative account of a well-known but little-heeded criticism of standard rate of return estimates. We regard the results as illustrative rather than as providing an operational criterion.

Our labor market survey permits us to estimate the rate of return on cognitive skill acquired in secondary school within the framework of our recursive model, which consists of an educational attainment function, an educational production function, and an expanded earnings function. It is possible, therefore, to address the issue of how to interpret the coefficient on the schooling variable in the standard earnings function rather than to beg the question in the usual way.

Four years of secondary schooling in Kenya, through their effect on cognitive skill, raise earnings throughout the working life by 33 percent. But the costs of secondary schooling depress the return on these benefits to 7 percent. The direct effect of schooling on earnings and the indirect effect through cognitive skill together account for the entire rate of return estimated by the standard method. Since the direct effect of schooling might represent either credentialism or elements of human capital not captured by our measure, we conclude that the social rate of return may be as high as that obtained from the standard method but could be substantially lower.

If the issue with which we have been concerned here were the only criticism of rate of return analysis, our findings would tend to vindicate the use of the standard methodology in Kenya. Although isolating the influence of cognitive skill reduces the rate of return, that rate remains positive and large.

Notes

1. There is evidence to refute the alternative interpretation—that secondary education enhances reasoning ability. In Tanzania the mean value of H in the weighted sample was much lower and the difference was statistically significant, reflecting the lower proportion of Tanzanians with secondary education, whereas the mean value of R was similar and the difference was not at all significant.

2. A log-linear specification with the continuous variables H and R in natural logarithms was also estimated but was inferior in that the percentage standard error of H was higher (29 percent) and the significance of some coefficients was lower.

CHAPTER 13

Public Sector Pay and Employment Policy and the Rate of Return to Education

IN THE COST-BENEFIT ANALYSIS of educational projects the presumption is that the wage structure is the product of the unfettered market interaction of sellers and profit-maximizing buyers of labor services and therefore accurately reflects the difference in productivity between more educated and less educated workers. It is well-known, however, that nonmarket forces influence wages. For example, in the United States, other things being equal, wages are higher in union than in nonunion establishments (see Freeman and Medoff 1981, and Lewis 1963), and there is also evidence that the educational structure of wages is more compressed in the former, creating a difference in the returns to education (see Freeman and Medoff 1981, and Shapiro 1978). Union behavior can thus influence and perhaps bias conventional measures of rates of return.

Wages in the public sector are set through complex administrative procedures. Government pay policy can therefore segment the labor market and influence the returns to education. This is less likely to occur where, as is often the case in high-income countries, governments adhere to the prevailing wage model of public sector pay determination, under which the public sector adopts the level and structure of wages in the private sector. Government pay policy is more likely to produce labor market segmentation in low-income countries. First, the public sector tends to be large; it often accounts for more than half of the wage earners in such countries. The importance of the public sector and, in some cases, its ability to restrict the intersectoral mobility of labor reduce the need for the government to act as a price taker in a competitive labor market. Second, in addition to the goal of allocative efficiency, governments in low-income countries have fiscal, employment, distributional, and political goals and often use public sector pay and employment policy to try to achieve them.

Does public sector pay policy bias conventional estimates of social rates of return to investment in education? In practice, economists have tended to ignore this issue, even for countries in which government adopts an active pay policy. And when the issue has been addressed (see Psacharopoulos 1981, p. 332),[1] the suggested resolution—that data for the private sector be used—may also prove unsatisfactory because it ignores interactions. It has long been recognized that changes in wages (and therefore in labor supply and demand) in union establishments influence labor supply and demand (and therefore wages) in nonunion establishments (Freeman and Medoff 1982). Similarly, the direct effects of government pay policy in the public sector are likely to have indirect effects on wages in the private sector. Indeed, the indirect effects may prove more difficult to analyze in this case because of the control of labor mobility that governments sometimes exercise.

Public sector employment decisions introduce a further complication into the calculation of social rates of return. When a union alters wages, private employers adjust the level of employment so that, given the new level and structure of wages, profits are maximized. Although wages differ between sectors, the equality of wages and marginal product is maintained. When the government alters public sector wages, the effect on employment is difficult to determine because the government does not necessarily act as a profit maximizer. The effect that government intervention in the labor market has on rates of return depends not only on the government's wage policy but also on its employment policy because the latter governs the relationship between wages and marginal productivity in the public sector.

Kenya and Tanzania differ markedly in their public sector pay policies. Whereas the Kenyan government has adopted the prevailing wage model, the Tanzanian government has used its control over pay in the public sector to equalize the distribution of wages. Government employment policies also differ, as suggested by the higher share of wage employment in the public sector in Tanzania (61 percent) than in Kenya (39 percent). We do not attempt to make definitive estimates of the rates of return for these countries. Our more limited aim is to examine the sensitivity of conventional estimates to alternative models of government pay and employment policy and of government control of labor mobility. We find considerable sensitivity, particularly in Tanzania. In the cost-benefit analysis of educational investment more attention must be paid to labor market policies for the public sector.

Conventional Estimates of the Rate of Return

As we have noted, the supply of secondary completers in relation to the supply of primary completers is much greater in Kenya than in Tanzania.

In Kenya the ratio of the stock of primary completers in wage employment to that of secondary completers is 1.17 to 1; in Tanzania it is 0.69 to 1. The occupational structure of employment is similar in the two countries; this and other evidence indicate that their relative demand functions for the two educational categories are similar (see chapter 7). Given the same relative demand functions, a competitive labor market model predicts a larger wage premium on secondary education, and therefore higher gross returns to secondary education, in the country with the smaller relative supply. If we assume a similar cost structure in the two countries, we would therefore expect the rate of return to secondary education to be higher in Tanzania than in Kenya.

This prediction, however, ignores the impact of government pay and employment policies, which differ greatly in the two countries. After the Arusha Declaration of 1967, which set Tanzania on a socialist path, the government adopted a policy of compressing the wage structure in the interest of greater equality. Although the policy applies throughout the wage sector (and beyond), it has far more leverage in government service and in parastatal (nationalized and partly nationalized) bodies than in private firms. Pay scales in both the government and the parastatal sectors are administratively determined. An organ of government lays down uniform occupational pay scales for all parastatal bodies on the basis of government pay scales. Government accounts for 24 percent of employees in the Tanzanian sample, and the parastatals account for 38 percent. The public sector is thus large enough to pursue an independent pay policy for many occupations without fear of losing workers to the private sector. We hypothesized, therefore, that pay in the public sector is lower at the higher levels and less dispersed than in the private sector and that the depressing effect of the pay policy on wages is more marked at the secondary than at the primary level. This hypothesis was confirmed in chapter 7. Because of the size of the public sector in Tanzania and the egalitarian pay policy of the government, the observed structure of wages differs considerably from the wages that would prevail in a competitive labor market.

In chapter 12 the earnings streams were derived from an aggregate function for the subsample of primary and secondary completers that included a dummy variable for secondary education. Here we use the full sample and obtain the earnings streams from separate functions for primary and secondary completers. The following is an example.

$$\ln W = a + bL + cL^2 + \sum_i d_i x_i + u \tag{13-1}$$

These cross-sectional earnings functions are used to simulate two time series, $\widehat{W}_p$ and $\widehat{W}_s$, that represent the predicted wages, over their expected working lives, of primary and secondary completers. The difference between the educational groups in predicted lifetime earnings is interpreted as a measure of the difference in productivity between the two groups that is attributable to cognitive skill or other marketable traits acquired in secondary education. The difference in earnings is used as the estimate of the social benefits of secondary education. In this chapter we abstracted from the issue that we discussed in chapter 12—the extent to which the social benefits of secondary education are reduced because employers use educational attainment to screen for natural ability or pay a premium for educational credentials irrespective of the impact of schooling on labor productivity.

Equation 13-1 is the basis for our analysis. The inclusion of the X_j terms, which we discuss further below, does not alter the two predicted earnings streams, nor, therefore, the rate of return, provided that the coefficients d are multiplied by the mean values $\bar{X}_j$ for each educational subsample. The implication is that differences in $\bar{X}_j$ between primary and secondary completers are attributable to secondary education. An advantage of including X_j is that when it is set equal to the mean value for primary and secondary completers combined, the part of the benefit stream that arises from subsample differences in such characteristics as race that are not attributable to secondary education can be eliminated. Among the X_j variables is J_k, a set of ownership category dummies, which captures the effect of government pay policy in the public sector. Other characteristics included in the X_j vector are race, sex, formal training, employment status (casual or regular), and occupation.[2] In the next section we use the J_k variables to estimate separate earnings streams, and therefore rates of return, for workers in the public and private sectors.

We estimated equation 13-1 for primary (standard 7) completers and for secondary (form 4) completers in both Kenya and Tanzania. As is generally the case, the predicted earnings of secondary completers at completion of schooling or soon thereafter exceed those of primary completers, and they rise more steeply with employment experience. The gross returns are similar in Kenya and Tanzania, and so are costs. Under the conventional method of estimation the aggregate net rate of return is 13 percent in both Kenya and Tanzania.[3] These results are not consistent with our expectation that returns are higher in Tanzania, where secondary completers are in scarcer supply. The explanation may lie in the differences between the two countries in public sector pay and employment policies and in the convention of ignoring those differences.

A potential weakness of these establishment-based surveys for cost-benefit analysis is that the sample excludes educated workers who are not in urban wage employment (see Psacharopoulos 1973). Like many rate of return studies that focus exclusively on urban wage employment, our estimate of the rate of return to secondary schooling may be subject to bias owing to differential labor market selectivity of primary and secondary completers. Our comparison of rates of return in the public and private sectors, however, is less likely to be subject to this source of bias.

The Sensitivity of the Rate of Return to Alternative Models of Pay and Employment Policy

The Competitive Labor Market Model

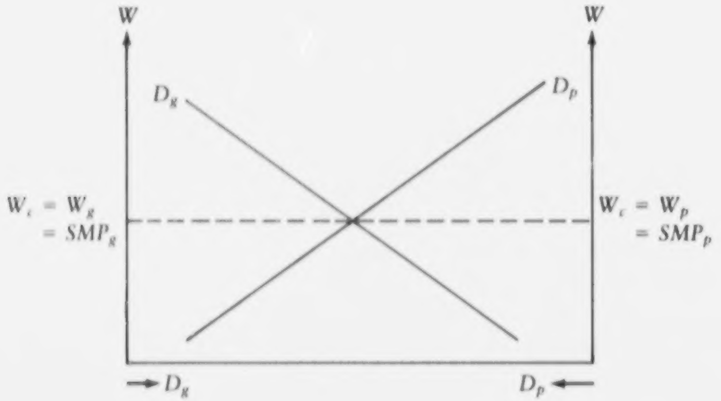
Figure 13-1 depicts the model of public sector pay and employment policy that underlies the method of estimating the rate of return to secondary education employed above. For heuristic purposes the model focuses on the absolute levels of productivity, wage, and employment of secondary completers rather than on their levels in relation to primary completers.[4] Assume a fixed supply of secondary completers (S), shown as the length of the horizontal axis. On the vertical axis is the wage (W) of secondary completers. The demand curve for the public sector (D_g) is measured to the right of the left-hand vertical axis, and that for the private sector (D_p) is measured to the left of the right-hand vertical axis. Both D_g and D_p are assumed to be downward sloping. If the labor market is perfectly competitive, then in equilibrium the wage equals the social marginal product of labor and no reallocation of secondary completers between sectors can increase output. Moreover, any intersectoral wage differential will be eroded through labor mobility. The competitive market wage (where $D_p + D_g = S$) is shown as W_c. The issue is whether this model best describes intersectoral wage relations in East Africa.

Wage Reduction Models

In figure 13-2 the government, motivated by fiscal or egalitarian considerations, intervenes and lowers the wage in the public sector from W_c to W_g. The pay and employment outcomes of this pay policy depend on the degree of government control over intersectoral mobility and on government employment policy. In panel A we assume that the government has complete control over the intersectoral allocation of labor and, in determining the level of public sector employment, behaves as a profit maximizer. The government can choose how many workers to employ irrespective of the wage it pays them. Given W_g, it chooses D_g. The supply of labor to the private sector is thereby reduced, and the private sector wage (W_p) is raised above W_c. Secondary completers in the private sector are paid substantially more than those in the public sector.

In panel B the government also has complete control over the intersectoral allocation of labor. In this case, however, social efficiency

Figure 13-1. *Public Sector Pay and Employment Policy: The Competitive Labor Market Model (Unconstrained Mobility; Profit Maximization)*



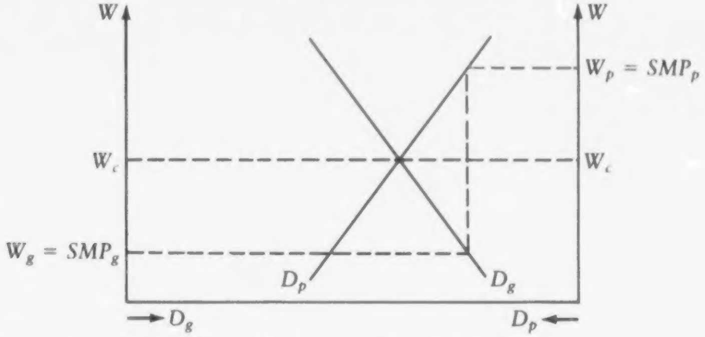
Note: W = wage of secondary leavers; W_c = competitive market wage; W_g = public sector wage; W_p = private sector wage; SMP_g = social marginal product in the public sector; SMP_p = social marginal product in the private sector; D_g = demand for labor in the public sector; D_p = demand for labor in the private sector; S_s = supply of secondary leavers.

in the allocation of labor determines the government's choice of the number of secondary completers in public sector employment. The government decides on the public sector employment level on the basis of the competitive wage, W_c. $W_c - W_g$ is, in effect, a windfall tax on public sector employees. The allocation of labor between sectors is not altered by pay policy. An intersectoral wage gap exists, but—because there is no reduction in the supply of secondary completers to the private sector—it is less than in panel A. The private sector wage is unchanged: $W_p = W_c$.

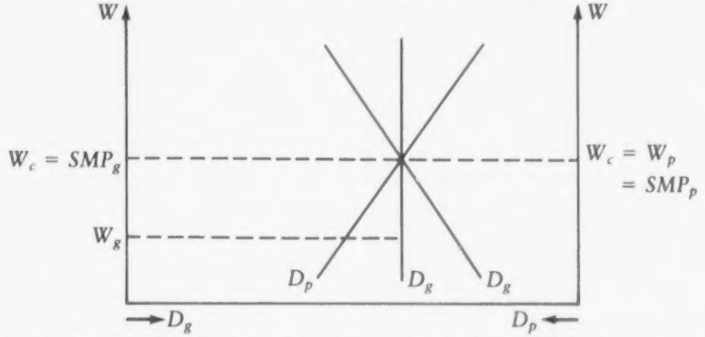
Panel C illustrates the case in which the government does not have complete control over the intersectoral allocation of labor. It is assumed that the public sector loses some of its secondary completers to the private sector on account of reduction in its wage, but mobility is not sufficient to eliminate the differential; that is, the government possesses some retaining power. Given that S_g is the supply curve of secondary completers to the public sector, the supply to the private sector is increased as a result of the cut in public sector pay. W_p therefore falls below W_c, but a differential remains: $W_p > W_g$. The differential is smaller than in either of the other cases.

Figure 13-2. *Public Sector Pay and Employment Policy: Wage Reduction Models*

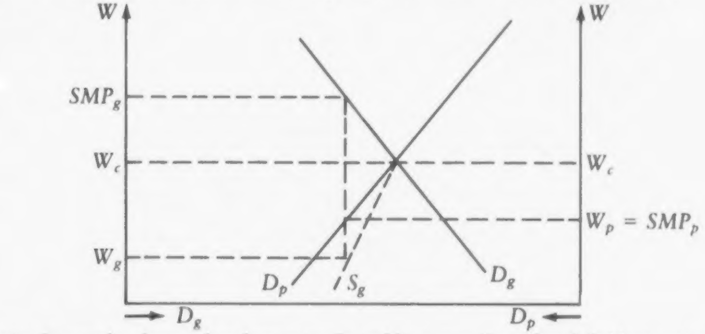
A. Totally Constrained Mobility; Profit Maximization


W
W
$W_p = SMP_p$
W_c
W_c
$W_g = SMP_g$
D_p
D_g
$\rightarrow D_g$
$D_p \leftarrow$

B. Totally Constrained Mobility; Allocative Efficiency


W
W
$W_c = SMP_g$
$W_c = W_p$
$= SMP_p$
W_g
D_p
D_g
D_g
$\rightarrow D_g$
$D_p \leftarrow$

C. Partially Controlled Mobility; Constrained Profit Maximization


W
W
SMP_g
W_c
W_c
$W_p = SMP_p$
W_g
D_p
S_g
D_g
$\rightarrow D_g$
$D_p \leftarrow$

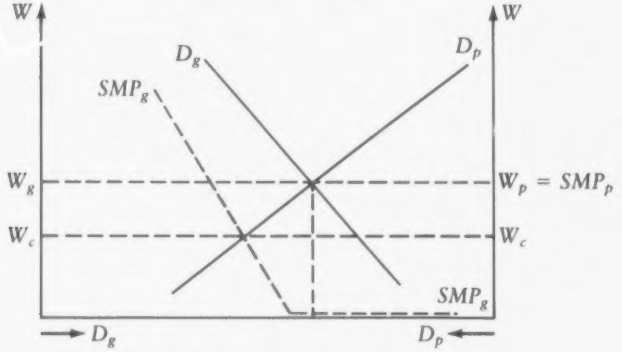
Note: S_g, supply of secondary leavers to the public sector. For other definitions see note to figure 13-1.

The Employment Expansion Model

Figure 13-3, like figure 13-1, assumes that the government acts as a price taker. In contrast to the competitive labor market model, however, the government does not behave as a profit maximizer in determining the level of public sector employment but attaches a value to public sector employment for its own sake. For instance, politicians may place a value on keeping the educated contented, or the bureaucracy may have the motive and the means to enlarge itself. In the figure SMP_g is the demand curve in a competitive labor market in which the public sector acts as a profit-maximizing employer, and W_c is the wage that is the outcome of competition and profit maximization. The actual demand for secondary completers in the public sector is D_g, which lies to the right of SMP_g.

At any given wage the government seeks to employ more secondary completers than would a profit-maximizing employer. The increase in public sector labor demand raises the total demand for secondary completers and therefore raises both W_p and W_g; in equilibrium $W_g = W_p > W_c$. This model of public sector employment policy does not itself involve an intersectoral wage gap, but it could be combined with the model of public sector pay policy depicted in figure 13-2. The government could intervene both to lower the wage and to employ at that wage more secondary completers than would a profit-maximizing employer.

Figure 13-3. *Public Sector Pay and Employment Policy: The Employment Expansion Model (Unconstrained Mobility; Overmanning)*



Note: For definitions see note to figure 13-1.

Rates of Return in the Public and Private Sectors

We examine whether public sector pay policy has segmented the labor market in Kenya and Tanzania. Are the (standardized) wages of primary and secondary completers significantly different in the two sectors? Do the observed differences in wages lead to intersectoral differences in the rate of return to secondary education? Are the observed differences in wages a consequence of labor market segmentation, or do they come about simply because one sector is more selective than the other about the human capital endowments of its employees?

Table 13-1 presents the regressions based on equation 13-1 that are used to predict the wage streams of primary and secondary completers. Our interest here is in the dummy variables (J_k) that indicate the ownership category (sector) of the firm by which the individual is employed. J_1 represents the private sector, J_2 the government sector, and J_3 the parastatal sector in Tanzania and the state corporation sector in Kenya. Together J_2 and J_3 make up the public sector. The coefficients on these variables indicate whether workers who in other respects have the same characteristics receive higher or lower wages simply because they are employed in the public or in the private sector.[1]

In the primary completer equation for Kenya the J_k dummies are small and are not statistically significant—that is, sector of employment has no independent influence on the wages of primary completers. In the secondary completer equation the coefficient on J_3 is not significant, but the coefficient on J_2 is significant and negative; that is, other things being equal, a secondary completer in government employment is paid less than in the private sector. The set of four coefficients suggests that in Kenya public sector pay policy has a mildly compressive effect on the wage premium earned by secondary completers.

In Tanzania all four coefficients on J_k are statistically significant. At the primary level the J_2 and J_3 coefficients are similar in value but of opposite sign, suggesting that on balance employment in the public sector has no independent influence on earnings. At the secondary level the J_2 and J_3 coefficients are large and negative—that is, other things being equal, a secondary completer earns substantially less in the public than in the private sector. The set of four coefficients suggests that in Tanzania public sector pay policy has had a substantial compressive effect on the wage premium earned by secondary completers.

We predict sector-specific earnings streams for primary and secondary completers as a basis for estimating separate rates of return to secondary education in the public and private sectors. For secondary completers the predicted earnings streams are given by:

Table 13-1. *Earnings Functions for Primary and Secondary Completers, from Equation 13-1*

	Kenya		*Tanzania*	
Variable	*Primary completers*	*Secondary completers*	*Primary completers*	*Secondary completers*
L	0.0412	0.0689	0.0348	0.0832
	(3.60)	(5.13)	(4.16)	(5.63)
L^2	−0.0005	−0.0011	−0.0002	−0.0013
	(1.52)	(2.17)	(0.17)	(2.74)
O_5	−0.3403	−0.3683	−0.4284	−0.1684
	(4.16)	(3.16)	(6.89)	(0.72)
O_4	−0.1896	0.2381	−0.3912	−0.4865
	(2.53)	(2.18)	(7.64)	(2.31)
O_{2b}	0.2030	0.2769	−0.0487	−0.2593
	(2.49)	(3.43)	(0.80)	(2.55)
O_{2a}	0.4968	0.6477	0.4744	0.1326
	(2.86)	(6.27)	(3.23)	(1.08)
O_1	0.7231	0.8702	0.4556	0.2927
	(4.77)	(8.42)	(3.66)	(2.61)
J_2	0.1112	−0.2761	−0.1954	−0.4680
	(1.29)	(4.73)	(3.03)	(5.39)
J_3	−0.1372	−0.0320	0.1539	−0.1493
	(1.49)	(0.35)	(3.56)	(1.94)
T_1	0.6342	0.3114	0.2137	0.3373
	(2.47)	(2.15)	(1.30)	(3.22)
S_1	−0.1267	0.0226	0.1394	0.0999
	(1.37)	(0.32)	(2.18)	(1.34)
R_2	0.0946	0.2288	0.0033	0.0908
	(0.96)	(1.63)	(0.04)	(0.27)
V_1	0.2041	0.0153	−0.0281	0.0709
	(2.57)	(0.27)	(0.57)	(1.06)
Constant	6.3089	6.2090	6.1799	6.4061
$\bar{R}^2$	0.362	0.530	0.376	0.586
F	20.31	36.72	26.60	29.84
N	443	412	552	266

Notes: L, employment experience; O_1, supervisory; O_{2a}, senior clerical; O_{2b}, junior clerical; O_4, semiskilled manual; O_5, unskilled manual; J_2, government ownership; J_3, parastatal; V_1, formal training; R_2, regular employment; T_1, non-African race; S_1, male sex. The figures in parentheses are t-statistics.

Primary completers are defined as workers whose highest educational level is primary standard 7 (or 8); secondary completers are those whose highest level is secondary form 4.

$$\ln \widehat{W} = a + bL + cL^2 + \sum_i d_i \bar{X}_i + \sum_k e_k J_k \tag{13-2}$$

When earnings for secondary completers in the public sector are being predicted, J_2 and J_3 are set equal to one; when earnings for those in the private sector are being predicted, J_2 and J_3 are set equal to zero. A similar procedure is followed for primary completers.[6]

In Kenya we estimate the rate of return in the private sector to be 15 percent, about 2 percent higher than the rate of return as conventionally measured. In keeping with the moderately compressive effect of public sector pay policy on the educational structure of wages, the rate of return in the public sector is estimated at 10 percent, about 3 percent lower than the aggregate. In Tanzania, as expected, public sector pay policy gives rise to a much larger intersectoral difference in the rate of return to secondary education. The rate of return is estimated to be 20 percent in the private sector and only 9 percent in the public sector.

Our presumption has been that the sectoral differences in rates of return are a result of the segmentation of the labor market—that is, some workers are paid more than others with the same human capital endowments simply because of their sector of employment. There is, however, an alternative explanation. We have documented elsewhere the high variance in cognitive skill among workers with the same number of years of schooling and have demonstrated that this variance is reflected in the wages paid to secondary completers; see chapter 3. It is also the case that the higher wages of government school completers compared with those of harambee school completers in Kenya can be entirely explained by the higher average cognitive skill level of the former; see chapter 15. It is reasonable to hypothesize, therefore, that the higher wages paid to secondary completers in the private sector are attributable to the "creaming" by private sector employers of the most skilled secondary completers.[7]

To test this hypothesis we estimate the following simple sectoral allocation function for secondary completers:

$$\text{Prob}(J_4 = 1) = \Phi(\mathbf{X}'\beta) \tag{13-3}$$

where J_4 is a dichotomous variable that takes the value 1 if the individual is employed in the public sector; the vector of exogenous variables includes L, our measure of employment experience, which in this case serves as a proxy for cohort of entry into the labor market; T_1 is a dummy variable indicating that the individual is non-African; and D_i is a set of dummy variables indicating performance on the form 4 examination. The examination scores are taken to measure differences in cognitive skill among secondary completers.

Table 13-2 presents estimates of the sectoral allocation functions and the predicted probabilities of being in the public sector for workers with different examination scores and employment experience. The coefficient

Table 13-2. *Probit Sectoral Allocation Functions and Predicted Probabilities of Employment in the Public Sector for Secondary Completers*

	Probit sectoral allocation function	
Variable	*Kenya*	*Tanzania*
D_1	−0.585	−0.783
	(1.39)	(1.10)
D_2	0.126	−0.577
	(0.50)	(1.11)
D_3	0.162	−0.918
	(0.70)	(1.82)
D_4	−0.194	−0.905
	(0.79)	(1.71)
L	0.053	0.012
	(3.86)	(0.69)
T_1	−1.318	−2.069
	(2.30)	(5.58)
Constant	−0.677	1.488
N	409	226
Scaled deviance	511.7	220.4

	Predicted probability of public sector employment, by length of experience and division of pass			
	Kenya		*Tanzania*	
Variable	*1 year*	*10 years*	*1 year*	*10 years*
D_1	0.11	0.23	0.76	0.80
D_2	0.32	0.50	0.82	0.85
D_3	0.31	0.49	0.72	0.75
D_4	0.21	0.37	0.72	0.76
D_5	0.27	0.44	0.93	0.95

Notes: D_1, division 1; D_2, division 2; D_3, division 3; D_4, division 4; D_5, failed or did not sit the examination; L, employment experience; T_1, non-African race. Figures in parentheses are t-statistics. The probability that $Y = 1$ is the area under the standard normal curve between $-\infty$ and $X'\beta$. Probabilities are predicted for African secondary (form 4) completers.

on the race variable is negative and significant in both countries, which indicates that, other things being equal, non-Africans have a higher probability than Africans of being employed in the private sector. In Kenya the coefficient on the experience variable is positive and significant, which indicates that the probability that a secondary completer will work in the private sector has increased over time; in Tanzania the coefficient is also positive but is not significant.[8]

Our principal concern is with the D_i variables. The table of predicted probabilities indicates that, consistent with our alternative hypothesis, in Kenya workers with the highest examination score (division 1, D_1) have the highest probability of working in the private sector. The coefficient on D_1 is not significant, however, and for those with the next highest scores (divisions 2 and 3) the probability of being in the private sector is lower than the probability for those with the lowest scores. We therefore reject the hypothesis that in Kenya the intersectoral wage differential among secondary completers is attributable to the greater selectivity of the private sector. The hypothesis is also rejected for Tanzania; there is no consistent relationship between examination performance and the probability of private sector employment, and only one of the four coefficients on the examination scores is statistically significant. The probability of being in the private sector is significantly higher for a form 4 leaver in division 3 than for one who failed or did not sit the examinations. A form 4 leaver, however, has a lower probability (although not significantly so) of being in the private sector if he is in division 1 than if he is in division 3. At least in Tanzania it appears that the gap in the rate of return to secondary education between the public and private sectors is indeed the result of the segmentation of the urban wage labor market by government pay policy.[9]

The Sensitivity of the Rate of Return

Consider the implications for the social marginal product of secondary completers, and therefore for the social rate of return to secondary education, of the alternative models of public sector pay and employment policy (table 13-3). Recall that in the competitive labor market model $W = SMP$ in both the private and public sectors and the intersectoral allocation of labor is efficient; that is, $SMP_g = SMP_p$. If the competitive model applies, the conventional method of estimating the social rate of return is appropriate. The application of the conventional method to our wage-segmented samples yields 13 percent in both countries (row 1).

In the wage reduction model depicted in figure 13-2, panel A, the government has complete control over the intersectoral allocation of labor and behaves as a profit maximizer. Therefore the government employs educated labor up to the point at which its perceived social marginal

Table 13-3. *Social Rates of Return to Secondary Education under Alternative Public Sector Pay and Employment Policies*

				Social rate of return					
				Kenya			*Tanzania*		
Model	*Public sector wage policy regime*	*Intersectoral labor allocation regime*	*Public sector employment policy regime*	*Private sector*	*Public sector*	*Aggregate*	*Private sector*	*Public sector*	*Aggregate*
Figure 13-1	Prevailing wage rate ($W_g = W_p$)	Unconstrained mobility	Profit maximization ($W_g = MP_g$)	–	–	13	–	–	13
Figure 13-2, panel A	Wage compression ($W_g < W_p$)	Totally constrained mobility	Profit maximization ($W_g = MP_g$)	15	10	13	20	9	13
Figure 13-2, panel B	Wage compression ($W_g < W_p$)	Totally constrained mobility	Allocative efficiency ($W_g < MP_g$)	15	10	15	20	9	20
Figure 13-2, panel C	Wage compression ($W_g < W_p$)	Partially constrained mobility	Constrained profit maximization ($W_g = MP_g$)	15	10	>15	20	9	>20
Figure 13-3	Prevailing wage rate ($W_g = W_p$)	Unconstrained mobility	Overmanning ($W_g > MP_g$)	15	0	9	20	0	8

— Not applicable.

product equals the public sector wage ($SMP_g = W_g$). Profit maximization also ensures that $W_p = SMP_p$. Thus,

$$W_p = SMP_p > W_c > W_g = SMP_g$$

In this case the social marginal product of educated labor is a weighted average of SMP_p and SMP_g. Similarly, the estimate for the aggregate social rate of return is the weighted average of the rate of return in the two sectors. This rate of return is, by choice of sectoral weights, the same for this model as for the competitive model—13 percent in both countries (row 2). Two assumptions are being made here, however: that additional secondary completers will be employed in the two sectors in the same proportions as those currently employed and that the price elasticity of the demand for labor is the same in the two sectors. If the elasticity is greater in the private sector, the hypothesized intervention by the government lowers the weighted average social rate of return below the rate that would prevail in a fully competitive market, and the reverse is true if the elasticity is greater in the public sector. Since the public sector weight for additional secondary completers can vary between 0 and 1, the weighted average social rate of return on secondary expansion is bounded by the rates of return for the private and public sectors.

In the windfall tax case, depicted in panel B, the government is assumed to allocate labor optimally between the two sectors:

$$W_c = W_p = SMP_p = SMP_g > W_g$$

The social marginal product of educated labor in the government sector exceeds the wage paid by the government. The wage prevailing in the private sector is therefore the measure of the social marginal product of educated labor. Similarly, the rate of return in the private sector indicates the aggregate rate of return to secondary education. This model of public sector pay and employment policy resolves the anomaly in our comparison of rates of return in Kenya and Tanzania. If this model applies, the aggregate rate of return is 20 percent in Tanzania and 15 percent in Kenya, where secondary completers are in relatively greater supply (row 3).[10]

In panel C the social marginal product of educated labor in the public sector, given by the demand curve SMP_g, exceeds the wage in both sectors:

$$SMP_g > W_c > W_p = SMP_p > W_g$$

The rate of return in the private sector is more appropriate than that in the wage sector as a whole (as conventionally measured) for estimating the aggregate social rate of return, but even the former yields a measure that is downward biased (row 4). The social marginal product of educated labor is a weighted average of SMP_p and the higher, but unobserved, SMP_g.

In the final case, illustrated by figure 13-3, the government does not maximize either public sector profits or social efficiency in the allocation of labor. The government demand curve does not reflect the social marginal product in the public sector; that is, $SMP_g < D_g$. Indeed, $SMP_g = 0$ over a range of public sector employment. In these circumstances, even if the government adopts the prevailing wage rate model of wage determination so that $W_p = W_g$, it is still true that $SMP_g < W_c$. The aggregate rate of return is the weighted average of the private sector rate of return and the zero rate depicted in the public sector. If this model applies, the aggregate rate of return, on the basis of the sectoral employment of those in the sample, would be 8 percent in Tanzania and 9 percent in Kenya. The rate is sensitive to the relative size of the two sectors, being lower the larger is the public sector. The rate of return on secondary expansion would, of course, depend on the sectoral destination of additional secondary completers; it could be zero.

Which of these models apply to Kenya and Tanzania? That the Tanzanian government's policy of compressing the wage structure in the public sector has not been thwarted by competitive forces indicates that the government has at least partial control over the intersectoral mobility of labor. This must be a consequence of the dominant position of the public sector, which accounts for 71 percent of the employment of secondary completers; in certain white-collar jobs the government is a virtual monopsonist. Complete control of intersectoral mobility is implausible, however, and we suspect that figure 13-2, panel C, applies. Moreover, the pressures on the government to expand employment for equity reasons and the incentive structure—for example, cost-plus pricing directives—are conducive to overmanning in the public sector, as depicted in figure 13-3.

Controls on mobility may not be the only reason for the persistence of the wage gap. The benefits to private employers of reducing wages may not have been sufficient to outweigh the risks of costs. Since many private employers are in the manufacturing sector, where labor costs are a small proportion of total costs, wage reductions would have a small impact on profits but might have a large impact on the morale (X-efficiency) of workers—a matter of particular concern in politically vulnerable non-African-owned enterprises.

Kenya more closely approximates the competitive labor market model (figure 13-1), but the moderate compression of the educational structure of wages in the public sector suggests that figure 13-2, panel C, may be relevant, and figure 13-3 may also apply to a certain extent. In both countries additional knowledge of the workings of the public sector labor market would be required to estimate definitive rates of return to secondary education.

Conclusions

The purpose of this chapter has not been to unveil the "true" rate of return to investment in secondary education in Kenya and Tanzania. Instead, we have tried to assess whether the usual practice of ignoring public sector pay and employment policy leads to biased estimates of the social rates of return to education. Our conclusion is that the ranking of investment priorities may be seriously distorted by failure to take account of the effects that policy-induced wage differences between the public and private sectors and differences between the wage and the marginal productivity of labor in the public sector have on the social marginal product of educated labor.

In both countries the social rate of return to secondary education is sensitive to the choice among several alternative models of public sector pay and employment policy. In Tanzania the range is at least from 8 to 20 percent; in Kenya it is at least from 9 to 15 percent. The greater sensitivity in Tanzania is attributable to the government's highly compressive public sector pay policy, which has segmented the wage labor market, and to the larger size of the public sector. In Kenya pay policy has conformed more closely to the prevailing wage model of public sector wage determination.

The standard method of estimation, by ignoring the issue, makes implicit assumptions about the underlying model of pay and employment policy without recognizing or attempting to validate them. Rate of return analysis should not be conducted mechanically; rather, it should be based on a knowledge of the government's objectives and behavior.

Notes

1. The argument is implicit in Psacharopoulos (1983).

2. The inclusion of the occupation terms allows us to use equation 13-1 in a separate analysis to simulate—by changing education-occupation matrices—the impact of educational expansion on the rate of return; see chapter 14. Note again that the inclusion of the occupation terms has no influence on the aggregate rate of return estimated in this chapter, a prediction that was empirically verified.

3. Costs include earnings forgone during schooling and job search, direct private expenses, and government subsidy. Benefits are based on pretax earnings. Only net-of-tax wage data were obtained from employees, but data on pretax and posttax wages were collected from employers for a subsample as a check. For these quadratic (in one case) and linear (in the other, where the quadratic

fit was less good) relations between pretax and posttax income were estimated, and these relations were then used to estimate the pretax wage of each employee in the full sample. The value of a percentage rate of return reported as x lies between x and $x + 1$.

4. If the market for primary completers is not segmented by sector—that is, if sector of employment has no independent influence on the wages of primary completers—then the size of the wage premium paid to secondary completers in the public sector in relation to that in the private sector can be inferred from a comparison of the absolute wages of secondary completers in the two sectors. This assumption corresponds fairly well to the evidence (see below).

5. The equations presented in table 13-1 are simply stratified versions of the "working regression" presented in chapter 7.

6. Recall that for the conventional aggregate rate of return the predictor equation for secondary completers included $\bar{J}_2$ and $\bar{J}_3$ for secondary completers, and similarly for all primary completers.

7. For a discussion of this type of sorting as an explanation of union-nonunion differences in wages, see Freeman and Medoff (1981).

8. The explanation for this difference between countries in the predictive power of the cohort variable is that Kenya has a larger stock of secondary completers than does Tanzania. In both countries white-collar jobs are concentrated in the public sector. Early cohorts of secondary completers are concentrated in these jobs and therefore in the public sector. In Tanzania the education-occupation matrix has not changed nearly as much over time as in Kenya, where secondary completers have entered manual occupations, and therefore the private sector, in increasingly large numbers.

9. To confirm further that the observed intersectoral wage differential for form 4 leavers is not simply a result of the private sector's creaming the most skilled workers, we entered the examination scores into the wage equations estimated for secondary completers. If performance on examinations and sector of employment are positively correlated, we would expect the coefficients on the public sector dummies to become smaller. In these regressions (not shown) the coefficients on the public sector dummies were reduced marginally in Kenya but not at all in Tanzania.

10. It must be this model, with its assumptions that the government completely controls labor mobility and that the sectoral allocation of labor is socially optimal, that underlies the suggestion by Psacharopoulos (1981) that the rate of return in the private sector should determine government policies regarding investment in education.

Chapter 14

The Rate of Return on Educational Expansion

INVESTMENT IN EDUCATION in developing countries has been subjected to cost-benefit analysis for the past twenty-five years or so, and rates of return have been estimated for more than forty countries. Perhaps the most influential stylized fact to emerge from these studies concerns the structure of returns to different levels of education.

In the first systematic overview of rate of return studies, Psacharopoulos (1973) concluded that "the most profitable educational level in most countries is the primary one" (p. 17). A World Bank (1980) policy paper on education summed up the evidence as follows: "The average social rate of return is significantly higher on primary education (26.2 percent) than on secondary education (13.5 percent) and higher education (11.2 percent)" (p. 44). Subsidization of costs implies even higher average private rates of return to primary education. In the most recent overview, Psacharopoulos and Woodhall (1985) present similar figures and conclude that "top priority should be given to primary education as a form of investment in human resources" (p. 55). They note that "the fact that cost-benefit calculations consistently show high rates of return to primary education . . . has led to a reassessment of the economic importance of primary education, both within the World Bank and in other international agencies" (p. 64).

It is our contention that these conclusions regarding the relative profitability of alternative educational investments are based on flawed estimates of rates of return. A methodological problem common to all these studies may bias substantially both the level and the structure of returns. In calculating expected benefits the assumption is made that the average wage of standardized labor measures the wage received by the marginal (that is, the most recently recruited) standardized worker. For example, in the estimation procedure the performance in the labor market of all

Note: Adapted from J. B. Knight and R. H. Sabot, "The Rate of Return on Educational Expansion," *Economics of Education Review* 6, no. 3 (1987), pp. 255–62.

those completing primary school in the cross section is used to generate the expected earnings stream of new primary completers. But the performance of primary completers who left school a decade or two earlier may be a hollow prospect for those just entering the labor market.[1]

The labor market conditions faced by new entrants can change dramatically as education expands. Many developing countries that started with very small educational systems chose to expand enrollments rapidly during the period 1960–80. Over that period enrollment rates in a group of thirty-two low-income countries rose from 37 to 70 for primary education, from 6 to 19 for secondary education, and from 1 to 2 percent for tertiary education, and in a group of 60 middle-income countries the rates rose from 75 to 100, from 14 to 39, and from 3 to 11 percent for the three levels, respectively (World Bank 1983, table 25). Wage employment has tended to grow much more slowly than enrollments. For instance, nonagricultural paid employment increased, on average, by 3.5 percent a year in seventeen developing countries for which statistics are available over roughly that period (International Labour Office yearbooks). As a result, growth in the supply of educated labor has tended to outstrip the growth of wage employment in many developing countries, necessitating substantial adjustments in the labor market.

In particular, the education-occupation matrix changes from one cohort to the next. Consider what has happened to primary completers in Kenya and Tanzania. In 1960 the primary enrollment ratio was 47 in Kenya and 25 percent in Tanzania. Primary completers were in scarce supply, and a primary school certificate was a passport to a white-collar job. Those who obtained those jobs remain in them today. But owing to the rapid expansion of the education system—both countries had achieved universal primary education by 1980—today's primary completer is fortunate to get even the most menial blue-collar job. Nevertheless, the continuing gap between self-employment income and the urban wage has provided each entry cohort with a strong incentive to secure urban wage employment.

In 1960 secondary enrollment ratios were 2 percent in both countries. In the following two decades enrollment grew at an annual average rate of more than 16 percent in Kenya and 8 percent in Tanzania. The rapid expansion of the secondary system, particularly in Kenya, suggests that the rate of return derived from cross-sectional data may be a poor guide to the rate of return on educational expansion at the margin.

In this chapter we assess whether the high rates of return on secondary and primary education, as conventionally measured, apply also to labor market entrants. By estimating marginal as well as average rates of return we attempt to measure the response of the rate of return to the decline in job prospects that accompanies the expansion of education.

Simulation of Educational Expansion: Methodology and Specification

We illustrate our method of estimating the marginal returns to education by applying it to secondary education. The now familiar equation 13-1

$$\ln W = a + bL + cL^2 + \sum_j d_j X_j + u \qquad (14\text{-}1)$$

is the basis for the analyses in the next section and is estimated separately for primary and secondary completers. The inclusion of the X_j terms does not alter the two estimated earnings streams—nor, therefore, the rate of return—provided that the coefficients d_j are multiplied by the mean values X_j for each educational subsample. The implication is that differences in X_j between primary and secondary completers are attributable to secondary education. An advantage of including X_j is that when the X_j terms are set equal to the mean value for primary and secondary completers combined, the part of the benefit stream that arises from subsample differences in X_j that are not attributable to secondary education can be eliminated.

A further advantage of including X_j in equation 14-1 is that it makes possible various simulation exercises based on hypothetical values of d_j or of X_j. In particular, the introduction of occupation variables permits examination of the effects on the predicted benefit stream of a simulated expansion of education. The estimated earnings function is therefore

$$\ln W = a + bL + cL^2 + \sum_j d_j X_j + \sum_i e_i O_i + v \qquad (14\text{-}2)$$

where O_i = occupation dummy variables and X_j = independent variables.

Particular care was taken in classifying workers into occupations on the basis of skill level (see appendix F for a discussion of the method of classification). In ascending order of expected skill the classifications are, for the manual occupations, unskilled (O_5), semiskilled (O_4), and skilled (O_3—the base subcategory in the dummy variable analysis) and for the nonmanual occupations, junior clerical (O_{2b}), senior clerical (O_{2a}), and supervisory (O_1). There is a monotonic positive association between years of education and expected occupational skill level in each sample. We saw in table 6-1 that the occupational distributions of the country samples are closely similar, whereas the two educational distributions are markedly different. This implies that the education-occupation matrices are different in the two countries. For instance, a far higher proportion of secondary completers are in manual occupations in Kenya than in Tanzania.

In earlier chapters we discussed filtering down—the process whereby workers of a particular educational level enter lesser jobs or (the reverse of the coin) the educational attainment of those entering a particular occupation rises. As might be expected from Kenya's larger stock of secondary completers in relation to employment opportunities, the filtering down of secondary completers into lower-level occupations has gone further there than in Tanzania. Moreover, the incidence of filtering down is cohort specific: the more recent cohorts of entrants into wage employment did more of the filtering down into manual occupations. Tracing a cohort between 1971 and 1980 by means of the manufacturing subsample and a comparable survey of the manufacturing sector in 1971 shows that only a minor part of the cohort difference in Tanzania can be explained by occupational upward mobility with employment experience.

These cohort effects reflect the extremely low rate of occupational mobility observed in both samples, which is the outcome of a number of related labor market phenomena. The mean values of years of employment experience per quit indicate remarkably low rates of labor turnover: on average a change of employer occurs only once in 9.3 years in Kenya and once in 16.8 years in Tanzania. As a combined result of legislation, trade union pressure, and the general ethos, incumbents enjoy considerable job security. Vacancies, when they occur, tend to be filled on the basis of educational criteria; for many jobs more educated applicants receive preference.

Many workers are considered to be undereducated for the jobs they perform, reflecting the limited provision of education in the past. The rapid expansion of education also helps to explain why employers consider the cohort differences in education more important than the cohort differences in employment experience. The preference ordering of educational levels by employers and the preference ordering of occupations by employees—which corresponds to our occupational classification by skill level—produce the same predictable process of filtering down in both countries.

There are three reasons for expecting occupation to influence earnings in Kenya and Tanzania: the importance of institutional wage setting, the low rates of labor turnover, and security of tenure. The last two factors suggest that competition in the wage labor market as a result of educational expansion is unlikely to be strong except among entrants. Since the occupational classification is based on skill, significant coefficients on the occupation dummy variables may represent occupation-specific human capital. Marketable skills of this sort would hinder the compression of the occupational wage structure brought about by educational expansion.

The inclusion of occupation terms in equation 14-2 permits us to assess the independent influence of occupation on earnings. Table 14-1 shows that for primary and secondary completers the occupation coefficients are indeed large and, with skilled manual as the base subcategory, their

Table 14-1. *Earnings Functions for the Uneducated and for Primary and Secondary Completers from Equation 14-2*

	Kenya			*Tanzania*		
Variable	*Uneducated*	*Primary*	*Secondary*	*Uneducated*	*Primary*	*Secondary*
L	0.0184	0.0412	0.0689	0.0161	0.0348	0.0832
	(1.32)	(3.60)	(5.13)	(1.76)	(4.16)	(5.63)
L^2	−0.0003	−0.0005	−0.0011	0.00001	−0.0002	−0.0014
	(1.21)	(1.52)	(2.17)	(0.08)	(0.17)	(2.74)
O_1	—	0.7231	0.8792	—	0.4556	0.2927
		(4.77)	(8.42)		(3.66)	(1.08)
O_{2a}	—	0.4968	0.6477	—	0.4774	0.1326
		(2.86)	(6.27)		(3.23)	(1.08)
O_{2b}	—	0.2030	0.2769	0.6466	−0.0487	−0.2593
		(2.49)	(3.43)	(2.36)	(0.80)	(2.55)
O_4	−0.1782	−0.1896	0.2381	−0.2344	−0.3912	−0.4865
	(1.10)	(2.53)	(2.18)	(3.18)	(7.64)	(2.31)
O_5	−0.0497	−0.3403	−0.3683	−0.2621	−0.4284	−0.1684
	(0.31)	(4.16)	(3.16)	(3.43)	(6.89)	(0.72)
J_2	−0.0227	0.1112	−0.2761	−0.1090	−0.1954	−0.4680
	(0.12)	(1.29)	(4.73)	(0.40)	(3.03)	(5.39)
J_3	−0.2607	−0.1372	0.0320	−0.1946	0.1539	−0.1493
	(0.85)	(1.49)	(0.35)	(1.40)	(3.56)	(1.94)
T_1	—	0.6342	0.3114	0.5228	0.2137	0.3373
		(2.47)	(2.15)	(1.24)	(1.30)	(3.22)
S_1	0.1696	−0.1267	0.0226	0.2303	0.1394	0.0999
	(0.91)	(1.37)	(0.32)	(2.75)	(2.18)	(1.34)
R_2	0.0546	0.0946	0.2288	0.1031	0.0033	0.0908
	(0.32)	(0.96)	(1.63)	(1.31)	(0.04)	(0.27)
V_1	−0.1673	0.2041	0.0153	0.1855	−0.0281	0.0709
	(0.53)	(2.57)	(0.27)	(1.65)	(0.57)	(1.06)
Constant	6.1527	6.3089	6.2090	6.0328	6.1799	6.4061
$\bar{R}^2$	0.016	0.362	0.530	0.424	0.376	0.586
F	0.86	20.31	36.72	11.78	26.60	29.84
N	81	443	412	162	552	266

— Not applicable.

Notes: L, employment experience; O_1, supervisory; O_{2a}, senior clerical; O_{2b}, junior clerical; O_3, skilled manual; O_4, semiskilled manual; O_5, unskilled manual; J_2, government ownership; J_3, parastatal; S_1, male sex; V_1, formal training; R_2, regular employment; T_1, non-African race. Primary leavers are defined as workers whose highest educational level is primary standard 7 (or 8), secondary leavers as those whose highest level is secondary form 4, and the uneducated as those without any primary schooling. Figures in parentheses are t-statistics.

ranking generally corresponds to the ranking of occupations by expected skill content. In only three out of twenty cases does the coefficient not differ from zero at the 5 percent level of significance. The job in which a secondary completer is employed makes a considerable difference to his wage. For instance, in Kenya employment in the skilled manual instead of the junior clerical occupation, other things being equal, reduces pay by 24 percent, and employment in the semiskilled instead of the skilled manual occupation reduces pay by 27 percent. The effect that filtering down by secondary completers has on the rate of return to secondary education is therefore potentially important.

The effect of education on earnings is both direct and—through the choice of occupation—indirect; education can influence a worker's wage within an occupation and the occupation in which he is employed. The difference in the earnings streams for primary and secondary completers is partly determined by their different occupational distributions. Accordingly the following predictive equation, derived from equation 14-2, is used to estimate the earnings stream of secondary completers during thirty-six years of employment ($L = 1, \ldots 36$).

$$\text{(14-3)} \quad \widehat{\ln W} = a + bL + cL^2 + \sum_j d_j \bar{X}_{j(p+s)} + \sum_i e_i \bar{O}_{is} + \sum_k f_k \bar{J}_{ks}$$

where $\bar{X}_{j(p+s)}$ = the mean value (proportion in the case of dummy variables) of X_j in the combined sample of primary and secondary completers and O_{is} = the proportion of secondary completers in O_i.

The earnings stream of primary completers is estimated in the same way, except that the coefficients are those estimated from the primary completer sample, O_{ip} replaces O_{is}, and $L = 1, \ldots 40$. The difference in earnings between primary and secondary completers as a result of their different distributions among the variables O_i is thus attributed to secondary education. Whether the occupation terms are included or excluded in the specification of equation 14-1, therefore, has no effect on the estimated rate of return; this expectation has been empirically verified.[2]

The theoretical model underlying our procedure is related to the models of "job competition" or "bumping," in which entrants to the labor market compete for jobs on the basis of their educational qualifications (see, for instance, Bhagwati and Srinivasan 1977, Fields 1974, and Thurow 1975). It differs from most such models, however, in permitting the productivity and wage of workers to vary not only between jobs but also within jobs according to education. Our model involves the concept of the occupational production function—an occupation-specific relationship between education and productivity in which productivity increases with education over a certain range, as discussed in chapter 7. The effect of occupation on earnings is shown by the coefficients on the occupation dummy variables in each sample, and the effect of education on earnings within an occupation can be derived by comparing the coefficients on a particular occupation in the primary and secondary completer samples, together with the other determinants of earnings of primary and secondary completers in their respective earnings functions.

The Rate of Return on Secondary Expansion

The existence of occupational coefficients that are both large and different at the two educational levels, together with the pattern of filtering down into lower-paying occupations that accompanies educational expansion, suggests a method of measuring the marginal rate of return. Essentially it is to substitute the occupational distribution of the most recent cohort for the occupational distribution of all cohorts combined (table 14-2). The change in the earnings of secondary completers as we move from the average to the marginal concept is

$$\Delta(\widehat{\ln W_s}) = \sum_i e_i(O^*_{is} - \bar{O}_{is}) \tag{14-4}$$

where O^*_{is} = the proportion of the most recent cohort of secondary completers in occupation *i*. A corresponding adjustment in the earnings stream of primary completers (the subscript *p* replaces *s* in equation 14-4) is necessary to obtain the net difference in earnings.

Table 14-2. *Occupational Distribution of All Cohorts and of the Most Recent Cohort, Uneducated Workers and Primary and Secondary Completers*

	Uneducated		*Primary*		*Secondary*	
Occupational group	*All cohorts*	*Most recent cohort*	*All cohorts*	*Most recent cohort*	*All cohorts*	*Most recent cohort*
Kenya						
O_1	0.0	0.0	3.6	1.9	11.2	3.0
O_{2a}	0.0	0.0	2.7	0.0	13.4	1.8
O_{2b}	0.0	0.0	15.6	8.6	43.2	42.5
O_3	14.8	5.6	31.9	22.8	12.7	14.3
O_4	30.4	16.7	26.6	28.6	10.0	16.2
O_5	54.8	77.8	19.6	38.1	9.5	22.2
Tanzania						
O_1	0.0	0.0	2.7	1.4	22.9	10.0
O_{2a}	0.0	0.0	2.0	1.4	14.3	7.8
O_{2b}	1.0	0.0	19.4	11.1	48.9	59.8
O_3	17.8	14.3	25.2	26.0	9.7	9.8
O_4	35.6	25.0	33.5	36.5	2.3	5.9
O_5	45.5	60.7	17.2	23.6	1.9	5.9

Note: For definitions of variables, see table 14-1. The most recent cohort consists of those who entered wage employment in 1975 or later.

This net difference clearly represents the private benefit of secondary schooling. If a person enters the labor market with secondary education, his wage expectation is based on the occupational distribution of similar secondary completers, and if he enters with primary education his wage expectation is based on the occupational distribution of similar primary completers. It may be argued, however, that the net difference in earnings so calculated overstates the social benefit.

Had secondary education not been provided, the posts that secondary completers occupy would have to be filled by primary completers, who would be in correspondingly larger supply. On this basis the social benefit stream for primary completers, derived from equation 14-3, would be

$$\widehat{\ln W_p} = a + bL + cL^2 + \sum_i d_i \bar{X}_{i(p+s)} + \sum_i e_i \bar{O}_{is} \tag{14-5}$$

The only difference between this and the corresponding stream for secondary completers is that the coefficients are those estimated for the primary completer sample and that $L = 1, \ldots 40$. The social benefit of secondary schooling is thus represented by the higher earnings of secondary completers compared with primary completers within the occupations that the former hold. The change in $\widehat{\ln W_p}$ as we move from measuring the average social benefit to measuring the marginal social benefit corresponds precisely to equation 14-4 except that the coefficients e_i are estimated from the primary completer sample; the underlying notion of the social benefit is retained.

It is implicit in these simulations that wages in the higher-paying occupations do not fall as education is expanded; that is, the coefficients in the earnings functions are invariant with respect to changes in the relative supply of secondary completers. Long lags in the adjustment process and inflexibility of wages are not implausible given the importance of institutional wage setting in Kenya and Tanzania, the low rate of labor turnover, the security of tenure enjoyed by incumbents, and the presence of occupation-specific human capital (see chapter 7).

Four concepts of the rate of return are reported in table 14-3. The average private return—the one conventionally estimated—overstates by between 1 and 3 percentage points the marginal private return derived if wage stickiness (a stable earnings function) and filtering down are assumed to exist. The estimate of the marginal return is based on the occupational distribution of the cohort that entered wage employment during 1975–80. It is somewhat lower than the average mainly because although both primary and secondary completers in recent cohorts had to filter down into lesser occupations, the secondary completers filtered down relatively further.

The average social return is considerably lower than the average private return in both countries. The difference—no less than 6–8 percentage points—reflects our assumption that if recent investment in second-

Table 14-3. *Average and Marginal Private and Social Rates of Return to Secondary Education in the Market Sector*
(percent)

Rate of return	*Kenya*	*Tanzania*
Private		
Average	16	19
Marginal	13	18
Social		
Average	10	11
Marginal	8	12

Notes: The private cost includes earnings forgone during schooling and job search and direct private expenses; the private benefit is measured as earnings net of tax. The difference between the private and social returns is that, for social returns, costs include the government subsidy, benefits include tax payments, and, as explained in the text, the earnings of primary leavers are based on the occupational distribution of secondary leavers. The difference between the average and marginal returns is that, for marginal returns, the earnings of primary and secondary leavers are based on the occupational distribution of the most recent cohort.

Only net-of-tax wage data were obtained from employees, but data on pretax and posttax wages for a subsample were collected from employers as a check. From these quadratic (in one case) and linear (in the other, for which the quadratic fit was less good) relations between pretax and posttax income were estimated and were then used to estimate the pretax wage of each employee in the full sample.

The value of a rate of return reported as x lies between x and $x + 1$.

ary education had not occurred, primary completers would be in the occupations now filled by secondary completers. Again, the marginal social return is less than the average social return in Kenya, but it is slightly higher than the average return in Tanzania. The social return is essentially based on a weighted average of within-occupation earnings premiums on secondary education. The filtering down of the most recent cohort into lesser occupations, in which the premiums on secondary education can be expected to be lower, would normally tend to depress the marginal social return below the average social return. The Kenyan outcome, rather than the Tanzanian, is therefore the more likely.[1]

The Rate of Return on Primary Expansion

No less than 78 percent of Kenyan secondary completers had nonmanual jobs, as against only 52 percent of the marginal cohort (table 14-2). Among Kenyan primary completers the proportion in white-collar jobs was 24 percent for all cohorts combined but 11 percent for the marginal cohort. Primary and secondary completers filtered down to a similar extent: more filtering down of secondary completers from white-collar occupations was largely offset by more filtering down by primary completers from the skilled manual category. Since all of the uneducated workers were in manual occupations, there could be no filtering down from white-collar occupations for this group.

A similar pattern of filtering down is evident in Tanzania. The main difference between the countries is that, at each educational level, both the marginal and nonmarginal cohorts are less concentrated in the less skilled occupations in Tanzania.

We have seen that the coefficients on the occupation terms in the equations for primary and secondary completers increase monotonically with skill level (table 14-1). These results demonstrate the sensitivity of the projected lifetime earnings stream to the occupational distribution of a cohort. Filtering down can substantially depress a cohort's lifetime earnings.

Uneducated workers, also analyzed in table 14-1, are an exception: in Kenya their occupation coefficients are small and not statistically significant, and the three white-collar occupations are empty. Even the coefficient on employment experience is small and insignificant. Their equation as a whole has poor predictive power because there is relatively little variance in earnings to explain. In Kenya what little change has occurred from one cohort to the next in the occupational distribution of uneducated workers will have only a limited impact on their projected lifetime earnings stream.

Educational expansion and filtering down pose more of a threat to the expected earnings of successive cohorts of uneducated workers in Tanzania than in Kenya. Uneducated workers in Tanzania are somewhat less concentrated at the bottom of the urban wage labor market, and a small proportion (1 percent) is even found in the lowest of the white-collar occupations. Moreover, three of the five occupational coefficients are larger than in Kenya and are statistically significant.

To take account of filtering down and to measure the marginal rate of return to primary education, we use a method similar to that for secondary education. We substitute for the occupational distribution of all cohorts combined the occupational distribution of the most recent cohort (table 14-2). In contrast to conventional rate of return studies, wages of workers with primary education are not inflated by basing the calculation on the (now unattainable) occupational distribution of earlier cohorts. The change in the earnings stream of primary completers, as we move from the average to the marginal concept, is

$$(14\text{-}6) \qquad (\widehat{\ln W}) = \sum_i e_i(O^*_{ip} - \bar{O}_{ip})$$

where O^*_{ip} = the proportion of the most recent cohort of primary completers in occupation i. A corresponding adjustment in the earnings stream of uneducated workers (the subscript u replaces p in equation 14-6) is necessary to obtain the net difference in earnings.

Table 14-4 presents our estimates of social rates of return to primary and secondary education by cohort. The estimates include government subsidies among the costs of education but do not follow table 14-3 in eliminating from the social returns the gains that might be attributable to occupation rather than education. Therefore the average social returns to secondary education given in table 14-4 lie between the average private and social returns given in table 14-3.

The average rate of return to primary education, as conventionally measured, is 17 percent in Kenya. When we substitute in the predictor equations the occupational distributions of the marginal cohorts of primary completers and uneducated workers, the rate falls to 12 percent. These calculations assume that uneducated workers begin urban wage employment at the same age (15 years) as primary completers. If it is assumed instead that uneducated workers begin earning before the primary completers, the average and the marginal returns decrease, but the relative difference between them stays the same.

The marginal return to primary education is lower than the average for two reasons: for primary completers there is both substantial filtering down and large differences in predicted wages by occupation, whereas for uneducated workers there is less scope for filtering down and predicted wage differences by occupation are small. The social rate of return to primary education falls, in essence, because the most recent cohort of primary completers is performing tasks for which primary education is less valuable.[4]

The return to secondary education in Kenya, by contrast, is not affected by the equivalent adjustment: both the average and marginal rates of return are 13 percent. Because the degree of filtering down of primary

Table 14-4. *Average and Marginal Percentage Social Rates of Return to Primary and Secondary Education*

Educational level	*Kenya*	*Tanzania*
Primary		
Average	17	11
Marginal	12	10
Secondary		
Average	13	13
Marginal	13	12

Note: Cost includes earnings forgone during schooling and job search and direct private and public costs of education. It is assumed that primary completers and the uneducated enter urban wage employment at the same age (15 years) and that secondary completers, having four more years of schooling but, on average, one less year of job search than primary completers, enter three years later. Rates of return are rounded to the nearest percentage point.

and secondary completers is similar, the difference in expected lifetime earnings is little affected.

The rapid expansion of primary education in Kenya might have produced an increasing difference over time in the qualities of primary and secondary completers, but our results cannot be explained in this way. First, the rate of expansion and the decline in selectivity were even greater among secondary than among primary completers (see chapter 10). Second, those primary completers who were successful in the intensified competition for scarce and relatively high paying wage jobs were increasingly likely to be among the best qualified.

As is consistent with the conventional view of the hierarchy of returns, the average return to primary education is substantially higher than that to secondary education. The marginal return to secondary education, however, exceeds that to primary education. Thus in Kenya the hierarchy is reversed.

The shift to the more appropriate marginal concept does not have as striking an effect in Tanzania as in Kenya. There is only a slight decline, from 13 to 12 percent, in the rate of return to secondary education, a result similar to that for Kenya. But the marginal rate of return to primary education, 10 percent, is only slightly lower than the average rate, 11 percent. In contrast to the findings for Kenya, Tanzania shows the conventional hierarchy of returns.

One explanation of why the marginal return differs little from the average return in Tanzania is that the smaller stock of secondary completers has not filtered down to the same extent as in Kenya. Thus neither primary completers nor the uneducated have felt as much competitive pressure in the urban wage labor market. As we have seen, a higher proportion of the uneducated is in skilled manual jobs than in Kenya, and a few of these workers are still to be found in junior clerical positions.

Furthermore, in contrast to Kenya, the occupation of an uneducated Tanzanian worker has a substantial impact on earnings. This implies that the shift to the occupational distribution of the marginal cohort reduces the lifetime expected earnings of uneducated workers as well as of primary completers, leaving the difference between them virtually unchanged. If this explanation is correct, then as the secondary system expands in Tanzania, we would expect reduced variance in earnings among uneducated workers and a widening of the gap between the average and marginal rates of return to primary education.

This explanation is not entirely satisfactory. We would expect the rapid expansion of the supply of primary completers in Tanzania to exert competitive pressure on the uneducated, irrespective of the pace of expansion of the secondary system. The less competitive nature of the Tanzanian labor market offers an alternative explanation for the greater variance in the wages of uneducated workers in Tanzania than in Kenya.

A markedly higher proportion of Tanzania's urban wage labor force is employed by the public sector, which provides greater security of tenure and is less sensitive to market pressures in wage determination. Although the lags may be longer there, adjustment to the increased supply of educated workers is occurring. We can expect to see less variance in the wages of uneducated workers and, as the filtering down of primary completers continues, a widening gap between the average and marginal rates of return to primary education.

Conclusions

The intention in this chapter has been to take account of a well-known but little-heeded criticism of standard rate of return estimates. Our data sets for Kenya and Tanzania have made possible a quantitative adjustment for this criticism. Nevertheless, we regard the results as illustrative rather than as providing an operational criterion.

In East Africa a skill-based occupational classification plays an important role in the wage structure. This can give rise to a substantial excess—6–8 percentage points—of the private return over the social return to secondary education. Some of the private benefit accrues in the form of access to high-paying occupations, with no increase in productivity. Whereas in a competitive labor market the marginal social return is the same as the average return, the marginal return is likely to be depressed in imperfectly competitive labor markets such as those of Kenya and Tanzania. In Kenya the marginal return to primary education in the wage employment sector was estimated to be 5 percentage points below the corresponding average return.

We have argued that the conventional wisdom about the hierarchy of the returns to education is based on studies that are likely to contain a methodological error. Although the rate of return on primary schooling, averaged over a large number of urban data sets, may be as high as 26 percent, our results suggest that the marginal return may be considerably lower, and it is the marginal rate of return that is relevant for policy.

Our adjustment to the conventional method is a step in the right direction. But our sample of urban wage employees, like all other such samples that have been used to estimate rates of return on primary education, raises additional questions. In all but a few developing countries most of the marginal cohort of primary completers will be entering agricultural self-employment. The return to primary education will thus crucially depend on its effect on productivity in agriculture and in rural nonagricultural activities.

Lockheed, Jamison, and Lau (1980) have surveyed studies that use agricultural production functions to measure this effect. Whereas in some countries the derived rate of return on primary education is high, in only nineteen of thirty-seven data sets is a statistically significant effect found. The influence of education on agricultural productivity appears to depend on whether there is an environment that encourages the modernization of agriculture. Clearly it is dangerous to generalize about the value of investment in primary schooling—even abstracting from questions of quality (see Behrman and Birdsall 1983), which may itself be a function of the expansion of the primary system.

We are not arguing that the conventional assessment of educational priorities, albeit based on the existing flawed rate of return studies, is necessarily wrong. The expansion of education can yield important distributional benefits and positive externalities. Contrary to the conventional wisdom about the hierarchy of rates of return, however, the jury is still out.

Notes

1. The potential influence of cohort effects—in particular, changes in the size of cohorts as a result of population growth—on the average returns per year of schooling has been established by Behrman and Birdsall 1988 for Brazil. The authors do not, however, examine the influence of cohort effects on the structure of returns to various levels of schooling.

2. To avoid the complications that arise from the equalizing government pay policy in Tanzania (see chapter 13), all estimates are for the private sector. In predicting the earnings streams W_p and W_s, the influence of pay policy is eliminated by setting to zero the coefficients on the dummy variable for ownership categories J_2 (government) and J_3 (parastatal), where J_1 (private) is the base subcategory.

3. The result for Tanzania is mainly the consequence of a large positive premium on secondary education in the unskilled manual occupational category. The coefficient on the unskilled manual dummy variable in the secondary completer sample, however, has a high standard error (table 13-1), and there are only five secondary completers in that occupation.

4. For the underlying theory of occupational production functions on which this statement is based, see appendix F.

CHAPTER 15

The Efficiency and Equity of Subsidies to Secondary Education

PRACTITIONERS OF THE NEW ECONOMICS of public finance, in searching for sources of revenue, regard as particularly strong candidates for taxation goods and services with low price elasticities of demand and high income elasticities of demand. The elasticities imply that if these items are taxed, the reduction of demand (and of potential revenues) and the consequent distortion of consumption patterns will be relatively small and that the share of revenue accruing from taxpayers in the upper ranks of the income distribution will be relatively large. The same rule of thumb applies to the consequences of reducing existing subsidies. In this chapter we exploit this symmetry to show how such an assessment might be conducted in the education sector in Kenya.

That education expenditures should be subjected to critical scrutiny is obvious; public spending on education accounts for a sizable proportion of GDP and of public expenditure in all regions of the world. In 1970, on average, developing countries spent 4 percent of GDP and 15 percent of total public expenditure on education (Zymelman 1982). Moreover, the combination of low enrollment ratios (in comparison with those in industrial countries), rapid population growth, and high private rates of return to investment in education means that the demand for education (and hence pressure to increase subsidies) is high and growing.

As a consequence of the macroeconomic problems of the early 1980s, budgetary constraints on educational expenditure in developing countries are tighter than in the 1950s and 1960s, when many subsidy programs were put into place or were greatly expanded. Governments' share

Note: Adapted from Jane Armitage and Richard Sabot, "Efficiency and Equity Implications of Subsidies to Secondary Education in Kenya," *The Theory of Taxation for Developing Countries*, David Newbery and Nicholas Stern, eds. (New York: Oxford University Press, 1987).

of output grew substantially in the 1960s and 1970s, and the proportion of the budget spent on human resources increased. But today public expenditure is no longer growing as a percentage of GDP, and expenditures on education and health face increasing competition from other claims (Bowman and Sabot 1982).

A further reason for scrutinizing expenditures on education is that after twenty or thirty years of economic development the original justifications for the subsidies may not apply with their original force or may not have proved sound. One justification for subsidies is the belief that the distribution of school places (and therefore the rate of intergenerational mobility) should not be determined by ability to pay school fees. Even if the private rate of return is high, capital market imperfections generally prevent the poor from borrowing to finance expenditure on education.

A second rationale is that the social returns to education are substantially higher than the private returns and that in the absence of subsidies investment in education will be less than is socially optimal. The increase in the supply of human capital can compress the earnings structure and consequently reduce inequality of pay. Education is also credited with helping to decrease fertility and child mortality and to increase political awareness and participation (see Bowen and Sabot 1983; Cochrane 1979). Externalities such as these, it is argued, justify subsidies.

A third reason for subsidies (and for government regulation) is that many parents are uneducated and may lack the background necessary to reach informed judgments about the relative costs and benefits of high-quality and low-quality schooling. Unless the government sets standards and subsidizes high-quality education, parents may settle for schooling of lower quality than is socially optimal.

The public finance rule of thumb and these justifications for educational subsidies suggest that an assessment of a program of education subsidies should include the following questions:

- Would a reduction of subsidies have a large negative impact on enrollments, or is the price elasticity of demand sufficiently low for that not to be the case?
- Would a reduction of subsidies have an adverse effect on the distribution of schooling, or, contrary to stated intentions, have the relatively well-to-do benefited disproportionately from the subsidization of education?
- Would a reduction of subsidy per pupil lead to a deterioration of school quality, or would private funds simply substitute for public funds, leaving expenditures per pupil on education inputs unchanged?

We attempt to answer these questions with regard to government subsidies of secondary education in Kenya. We were unable to obtain the relevant cost data for community and private secondary schools in Tanzania, and, moreover, the Kenyan case is more interesting because the harambee system of secondary schools is much larger than its equivalent in Tanzania. A distinction is made in the analysis between the consequences of the two ways of reducing subsidies to secondary education—raising fees in government schools, and leaving the growth of secondary enrollments to relatively unsubsidized private schools.

The Dual Secondary System in Kenya

Between 1963, the year of independence, and 1980 enrollments in the highly subsidized government secondary system expanded rapidly, at 12 percent a year. Demand grew even faster than supply. The excess demand was satisfied by the establishment of large numbers of harambee, church, and private schools, which receive only small subsidies from the government. Since 1963 private enrollments, including those in government-assisted harambee schools, have been growing at 21 percent a year. Secondary enrollment in nongovernment schools first exceeded that in government schools in 1975. In 1981, 40 percent of enrollment was in government schools, about 20 percent was in assisted harambee schools, about 20 percent was in unassisted harambee schools, and the remainder was in church or private schools. The state secondary system is clearly preferred.[1] With few exceptions, harambee schools are attended by primary leavers who did not qualify (on the basis of meritocratic criteria) for a government secondary education. Table 15-1 shows why.

Because subsidies are much larger in the government system than in the harambee system (2,071 shillings per student a year, compared with 227 shillings), the cost borne by parents is much smaller in the government system (1,557 shillings per student a year, as against 2,460 shillings for harambee schools).[2] Moreover, government schools appear to be higher in quality. Total annual expenditures are roughly 1,000 shillings per pupil higher in government than in harambee schools, and this difference translates into better-educated teachers, smaller classes, more textbooks, and better physical facilities. Yet harambee schools prepare students for the same lower-secondary-leaving examinations taken by students in government schools; they are not attempting to offer, for example, vocational training rather than an academic education. The difference in inputs is reflected in differences in outputs. Only 15 percent of students in government schools drop out before reaching form 4; for harambee schools the figure is 58 percent. Similarly, 21 percent of government school students attend upper secondary school (forms 5 and 6), which is the gateway to a higher education, compared with 1 percent for

Table 15-1. *Characteristics of Government and Harambee Schools, Kenya 1980*

Item	*Government schools*	*Harambee schools*
Cost per pupil (shillings per year)		
Private direct	1,557	2,460
Public direct	2,071	227
Total direct	3,628	2,687
Wages forgone[a]	6,960	6,960
Highest secondary form achieved (percentage distribution)		
Form 1	2.6	9.1
Form 2	9.7	40.9
Form 3	2.6	8.4
Form 4	64.1	40.2
Form 5	0.2	0.0
Form 6	20.7	1.3
Form 4 examination score (percentage distribution)		
Division 1	19.4	3.2
Division 2	27.5	6.3
Division 3	32.7	33.3
Division 4	16.5	42.9
Failed	2.9	12.7
Did not sit	1.2	1.6

Notes: The figure for average private expenditure per pupil for harambee schools is a weighted average of the expenditures in assisted and unassisted harambee schools, where the weights are the proportions of total enrollment in the two types of harambee school. Similarly, the figure is for private expenditure per pupil for government schools are weighted by enrollment.

The government expenditure figures are aggregates; to obtain per pupil expenditures it is necessary to use the appropriate enrollments. Although public expenditure on harambee schools is confined to assisted harambee schools, the appropriate enrollment figure for our purposes is total harambee enrollment. Since our other cost data and our returns data refer to 1979, we inflate government expenditure, using the official government estimate of the 1980 inflation rate, 12 percent.

[a] Primary leavers' wages forgone, annual average over first four years, predicted with wage functions presented in table 15-2.

Source: Census administered by the Central Bureau of Statistics in collaboration with the ministries of Basic and Higher Education.

harambee schools. Students in government schools perform markedly better than their harambee school counterparts on the standardized examination taken at the conclusion of form 4; 47 percent of government form 4 leavers were in the top two divisions, compared with 10 percent of harambee form 4 leavers. Fully 56 percent of harambee leavers were in the lowest division or failed, as against 19 percent of government leavers.

This difference in performance on examinations is consistent with our other evidence for a difference in school quality, but it could also be partly the result of differences in student quality, given the meritocratic selection criteria for entrance to government schools. Although we do not have evidence on ability levels for the entire sample, we do have results on Raven's Coloured Progressive Matrices, a test of reasoning ability, for a subsample of form 4 leavers (see chapter 3). The difference in scores between harambee and government school leavers is small (the means being 30.52 and 28.32, respectively) and, indeed, statistically insignificant. (The standard deviations are 4.85 and 7.90, respectively.) Nevertheless, government school students are likely to be better qualified on entrance than harambee school students because of differences in quality of primary schooling and in academic skills acquired at home.

The difference between government and harambee leavers in levels of skills as measured by the examinations is, in turn, reflected in a large difference between the two groups in the earnings they command in the labor market. The predicted mean wages of workers with ten years' experience, in shillings a year, are 9,273 for primary leavers, 12,518 for form 4 leavers from harambee schools, and 16,897 for form 4 leavers from government schools. Predicted mean wages for secondary leavers are substantially higher than predicted wages for primary leavers, but workers who attended government secondary schools earn 23 percent more than those from harambee schools.[3]

In the parlance of cost-benefit analysis, these stylized facts suggest that the private costs of investing in a secondary education are lower and the private returns are higher for those who gain access to a government secondary school than for those who must attend a harambee school. The resulting difference in net private returns explains parents' strong preference for government schools. If, for now, we ignore the effect of individual constraints on paying for secondary education when the market for secondary education is segmented, the implication is that the subsidy per pupil in government schools can be reduced (user fees increased) without affecting the demand for places in government schools or expenditure per pupil and hence without reducing school quality. A simple economic model of the demand for schooling predicts that in a dual school system there will be excess demand for places in the relatively small, highly subsidized segment of the system. The elasticity of effective demand in that segment will therefore be zero and will remain zero until fees are raised sufficiently to equate the private net rates of return in the two segments.[4] If the highly subsidized segment is also higher in quality and hence in gross returns, the fees charged in that segment will actually have to be higher than the fees in the other segment before net rates of return are equalized.

An increase in fees in Kenyan government secondary schools would ease budgetary constraints on education, which have tightened in the

1980s.[5] Public resources for secondary education will also be limited by the higher government priorities attached to primary and higher education. The Kenyan government is committed to free and universal primary education. The primary system must expand by 3.8 percent a year simply to keep pace with population growth.

Whether the Kenyan government takes advantage of the revenue-generating potential of user fees in government schools, however, also depends on the consequences of a rise in those fees for the distribution of secondary places and for the size of the secondary system as a whole. An important consideration is whether a substantial increase in user fees would force families with relatively low incomes to transfer their children to the private school system or to terminate their education.

Table 15-2 shows that the probability of attending a government secondary school rises monotonically and steeply with the educational level of the child's parents, which is an indicator of socioeconomic status.[6] Moreover, those children whose parents are most able to bear the cost of their education are the most likely to receive large subsidies. The explanation may lie in differences among socioeconomic groups in the quality of primary schooling, in the quantity and quality of training provided within the home, and in the ability to "purchase" places in government schools. Whatever the cause, it appears that in Kenya the incidence of subsidies for secondary education—a private good that substantially raises the lifetime income of the recipient—strongly favors those who rank relatively high in the distribution of income. A rise in user fees is likely, therefore, to reduce the inequality of real income among households.

A zero price elasticity of effective demand (given the rationing of

Table 15-2. *Predicted Probability of Attending a Government School, by Parents' Education, Kenya*

		Percentage distribution of parents' education, by type of school	
Parents' education	*Probability*	*Government*	*Harambee*
F_1	0.16	38.2	49.0
F_2	0.23	24.6	27.1
F_3	0.33	27.1	20.0
F_4	0.51	10.1	3.9

Note: In the tables in this chapter: F_1, both parents with no education; F_2, one parent with primary education and one with none; F_3, both parents with primary education or one with secondary or higher education and one with none; F_4, one parent with primary education and one with secondary or higher education or both with secondary or higher education.

places) implies that a rise in user fees will not lead to underutilization of government schools. If some students withdraw from the government system, others from the harambee system will take their places in the preferred system. But what happens to secondary enrollment as user fees are increased depends on how many leave the government system and whether they switch to the harambee system or leave the secondary system entirely.[7] These magnitudes will depend on the composition of the government system. If, at one extreme, the government system were entirely occupied by the children of the group with the highest education and therefore income, a rise in fees would be unlikely to induce withdrawals. But as we have seen, in Kenya children of parents with no formal education, despite their low probability of attendance, still make up 38 percent of the government secondary system because such a high proportion of parents had little or no formal education. Another 25 percent of places is filled by children with one parent with primary education. This suggests that unless the rise in school fees is discriminatory—that is, imposed only on those "able to pay"—it may induce substantial withdrawals from the government system and perhaps from the secondary system entirely.

Methods and Data

Our interest is in the apparent dualism in the market for secondary education between the high-quality, high-subsidy government system and the low-quality, low-subsidy harambee system. We therefore depart from the conventional procedure by disaggregating the benefits and costs of secondary schooling by type of school and calculating separate rates of return to government and to harambee schooling. When the internal *private* rate of return that equates the present value of these benefits to zero is calculated, only the opportunity costs (wages forgone) of attending secondary school and the private direct costs are netted out. When the *social* rate of return is calculated, account must also be taken of public direct costs (subsidies). On the benefits side we disaggregate by estimating earnings functions that will yield $\widehat{W}_{sg}$ and $\widehat{W}_{sh}$, which represent the predicted wages, over their expected working lives, of government and harambee secondary completers, respectively. The equation is

$$\ln W = a + bL + cL^2 + \Sigma d_j S_j + \sum_i e_i X_i + u \qquad (15\text{-}1)$$

where S_j are dummy variables that signify type of secondary school.[8]

The predictor equation for primary completers simply excludes the S_j terms. Excess demand for government schooling is sufficient to establish that the price elasticity of demand is zero. Comparison of the private rate of return to investment in government schooling, r_g^p, with the private rate of return to harambee schooling, r_h^p, allows us to assess the extent to which user fees can be raised (or subsidies lowered) without inducing a reduction in enrollments. On the assumption that the private rate of return to government schooling is greater than that to harambee schooling ($r_g^p > r_h^p$), and that there are no financial constraints, we calculate the increase in direct costs required to make the two rates equal ($r_g^p = r_h^p$).

If the subsidy per pupil in secondary education is reduced by leaving further expansion to the low-cost, low-quality private sector, will allocative efficiency suffer? Because both the total costs and the benefits of government schooling appear to exceed those of harambee schooling, our stylized facts did not permit even a preliminary answer to this question, which requires a comparison of the social rates of return, r_g^s and r_h^s. The answer depends on which has the greater effect on the social rates for the two systems: the difference in costs or the difference in benefits. If the social rate of return to government schooling is equal to or less than that to harambee schooling ($r_g^s \leq r_h^s$), reducing the subsidy per pupil would not reduce the economic efficiency of the school system. If the social rate of return to government schooling is greater than that to harambee schooling ($r_g^s > r_h^s$), allowing the harambee system, as currently constituted, to increase its share of enrollments would mean a loss in expected efficiency.

The deficiencies of cost-benefit analysis as a guide to the allocation of resources between secondary schools and other types of investments such as health clinics or railroads are well known, and various ad hoc adjustments have been devised to correct them (Psacharopoulos 1973). Our more limited aim—comparing the social rates of return for two components of the secondary system as a means of assessing the efficiency consequences of reducing the subsidy per pupil—is less subject to some of the biases that can be a source of concern. For example, the precise nature of the relationship between wages and the marginal product of labor in the public sector may have a large influence on the social rate of return to secondary education but only a small effect on the relative rates of return to government and harambee schooling. Although there is a large difference between the proportions of primary and secondary completers in the white-collar-intensive public sector, the difference between government and harambee secondary completers in this regard is relatively small. Wage-experience profiles derived from cross-sectional data are only crude approximations of earnings over the life cycle,[9] but again, the relative rate of return to government and harambee schools is less likely to suffer from bias on this account than is the aggregate rate of return to secondary education.

We do, however, examine empirically four issues that could have an important bearing on relative private or social rates of return. Where appropriate, we devise methods for adjusting our estimates.

- Are the higher lifetime earnings of government school completers in comparison with those of harambee completers attributable to their higher level of skill or to credentialism—discrimination by employers on the basis of the worker's "old school tie"? We employ more refined measures of human capital—scores on the form 4 examinations—to shed light on this question.
- Do government and harambee completers differ in the length of time unemployed after leaving school, and are relative rates of return sensitive to the observed differences? Measures of time devoted to job search on leaving school permit us to examine these relationships.
- Do relative rates of return have to be adjusted for the difference in wastage rates between government and harambee schools that was noted above? The answer depends on whether the returns to schooling and the costs are linear or nonlinear functions of years of schooling.
- How much of the difference between government and harambee completers in skill levels and earnings is attributable to the tendency of children from more educated backgrounds to attend government schools rather than to differences in the quality of schooling? We estimate an educational production function to isolate the effect of family background, independent of type of school, on performance on the school-leaving examination. We then simulate what the differences between government and harambee completers in performance and in earnings would be if the two groups did not differ in family background.

With the exception of opportunity costs, we do not have individual data on costs. In our rate of return calculations all government completers are assumed to have paid the average current costs of government schools, and all harambee completers are assumed to have paid the average current costs of harambee schools. Private and public cost data are derived from official government statistics. Our estimates of private direct costs—tuition and board, uniforms, books and equipment, and other school charges—and of public costs are obtained from official sources. Our own survey is the source for the opportunity costs and for returns to government and harambee secondary education.

Our survey has the strengths of accuracy and richness. One of its advantages is that it allows the type of secondary school attended to be identified, and hence the rates of return that are central to our analysis can be compared. The variable for performance on form 4 examinations permits us to test competing hypotheses regarding the cause of the difference between harambee and government completers in earnings streams, which is an essential step in measuring the gap between the two types of school in gross social returns. It also permits us to estimate an educational production function and to correct, if only crudely, for the bias in the measurement of the gap that arises from the selectivity of the government system.

Our establishment-based survey—like any such survey—has a weakness when it is used for cost-benefit analysis: because the sample does not include those educated workers who are not in urban wage employment, our estimate of the relative rates of return to government and harambee schools may be subject to sample selection bias. In particular, it seems likely that a higher proportion of harambee completers than of government completers are not in urban wage employment and that those harambee completers who do not obtain such employment are from the poorest-quality schools. If those schools have below-average costs as well as below-average returns, our comparison need not be biased. If, however, only the returns are below average, the implication would be that we are overestimating the returns to harambee schools in relation to the returns to government schools.

Private and Social Rates of Return to Government and Harambee Schools and Some Adjustments

Table 15-3 presents estimates of the earnings functions used in the analysis. In both equations—for primary completers and for secondary completers—the coefficient on the experience variable is positive and highly significant, and the coefficient on the quadratic term is negative and highly significant. Differences between the two equations in constant terms and in the coefficients on the experience variables indicate that, as usual, the earnings profile of secondary completers lies above the curve for primary completers and rises more steeply.

The coefficient on the harambee dummy variable in column 2 of table 15-3 is negative, large, and significant. The implication is that when employment experience is standardized, the earnings of harambee completers are considerably (more than 21 percent) lower than those of government completers. This estimate of the standardized differential in earnings may be biased because the returns to experience are constrained to be the same for government and harambee completers. But an *F*-test on an unconstrained version of the equation (not shown) did not allow us to reject the null hypothesis that the returns to experience are the same for both groups; the *F*-statistic was below the critical value at the 5 percent level of significance.

Figure 15-1 shows the lifetime earnings streams of primary completers, government secondary (form 4) completers, and harambee secondary completers. The lower shaded areas represent the opportunity cost of secondary schooling;[10] the upper shaded area represents the higher gross pri-

Table 15-3. *Earnings Functions Containing Type of School and Performance on Form 4 Examination, Kenya*

Independent variable	*Primary completers*	*Secondary completers*		
	(1)	*(2)*	*(3)*	*(4)*
L	0.045	0.099	0.099	0.099
	(4.8)	(9.7)	(10.0)	(9.5)
L^2	−0.0005	−0.0016	−0.0019	−0.0019
	(1.6)	(4.3)	(4.6)	(4.2)
S_2	—	−0.21	−0.024	—
		(2.9)	(0.3)	
S_3	—	−0.20	−0.016	—
		(3.2)	(0.2)	
S_4	—	−0.15	−0.20	—
		(1.6)	(1.8)	
E_5	—	0.64	0.30	0.42
		(10.9)	(4.4)	(6.5)
D_1	—	—	1.00	—
			(8.5)	
D_2	—	—	0.70	—
			(7.6)	
D_3	—	—	0.47	—
			(5.5)	
D_4	—	—	0.27	—
			(3.1)	
D_1 or D_2	—	—	—	0.41
				(7.7)
Constant	6.25	6.58	6.08	6.40
$\bar{R}^2$	0.19	0.40	0.45	0.45
N	458	508	456	456

— Not applicable.

Note: L, employment experience; S_2, harambee secondary school; S_3, private secondary school; S_4, government technical school (for the S variables, S_1, government school, is the base); E_5, post–form 4 education (form 4 is the base); D_1, division 1 on the form 4 examination; D_2, division 2; D_3, division 3; D_4, division 4 (for the D variables, D_5, failed or did not sit the examination is the base, except for the entry "D_1 or D_2," where the lower divisions, D_3, D_4, and D_5, constitute the base). The dependent variable is the natural logarithm of monthly wages, ln W. Figures in parentheses are t-statistics. Column numbers identify different regression specifications.

vate returns to government than to harambee secondary schooling.

Table 15-4 presents our estimates of the private and social rates of return to government and harambee schooling on the basis of the data underlying the above estimates of returns and opportunity costs and the estimates of private and government expenditures presented in table 15-1. As the stylized facts strongly suggested, the private returns to government schooling are higher—50 percent higher—than the private returns to

Figure 15-1. *Costs and Benefits of Government and Harambee Secondary Schooling*

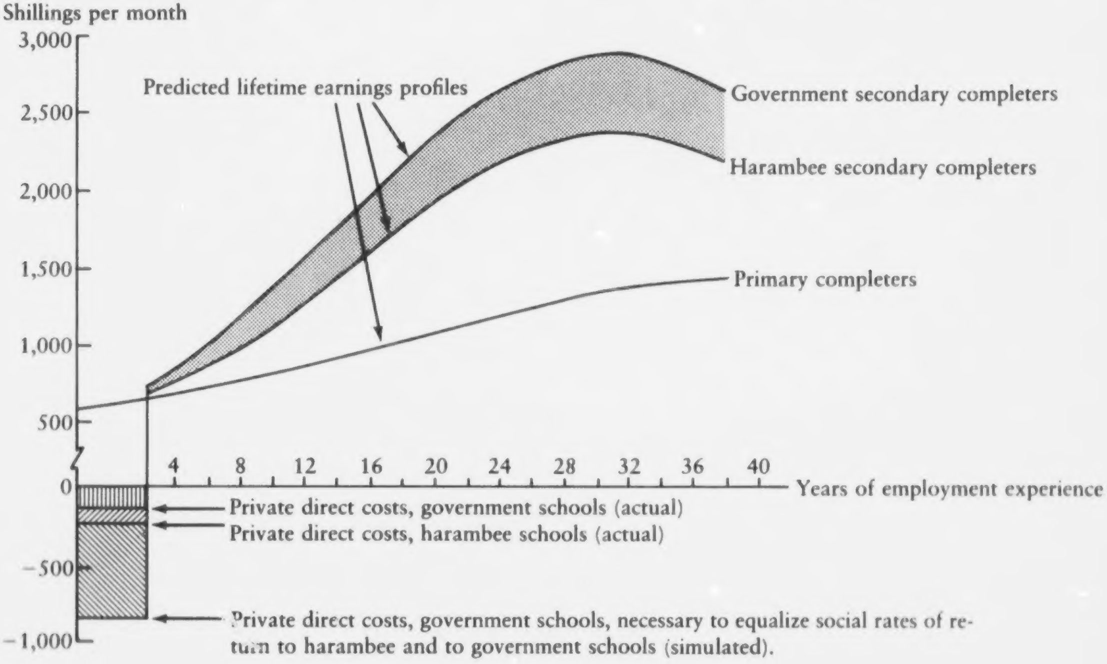


Table 15-4. *Private and Social Returns to Secondary Education, Kenya*
(percent)

Return	*Government schools*	*Harambee schools*
Base calculation		
Private	14.5	9.5
Social	13.0	9.5
Adjusting for credentialism		
Private	14.5	9.5
Social	13.0	9.5
Adjusting for wastage		
Private	14.5	7.5
Social	13.0	7.5
Adjusting for search time		
Private	21.0	11.5
Social	17.0	11.5
Adjusting for selectivity of government schools[a]		
Base private	15.5	11.0
Base social	13.5	11.0
Adjusted private	15.0	—
Adjusted social	13.0	—

— Not applicable.

a. The base private and social returns are recalculated because a slightly different specification of the earnings function underlying our estimate of returns is used to make the adjustment.

harambee schooling. This implies that user fees in government schools would have to be raised substantially to equalize private returns in the two systems.

Our simulations indicate that to accomplish such an equalization private direct costs in government schools would have to be raised from 1,557 shillings a year to 10,000 shillings a year.[11] The difference between what the government could charge, given perfect capital markets, and what it actually charges over four years is therefore more than 33,000 shillings. This sum is double the mean annual earnings of all workers in our sample, considered by some to be the urban elite; it is 3.5 times the mean annual earnings of the manual workers in our sample.

If the elasticity of demand for government schooling remains zero until private returns in the two segments of the system are equalized, the revenue potential of raising user fees is then simply the difference between current user fees and the maximum potential fee multiplied by aggregate enrollment in government secondary schools. This comes to 1,500 shillings, or more than 300 percent of government recurrent expenditures on secondary education (see Bertrand and Griffin 1983).[12] Capital market imperfections imply that if the maximum potential user fee is charged, demand for government schooling will decline. High-cost, high-quality private schools now enroll only a small proportion of secondary students, and expansion of these schools could drain revenue from the government system. Nevertheless, the revenue potential of raising school fees is likely to be substantial.

The private and social returns to harambee secondary schooling are essentially the same. Adding the negligible government subsidies onto the private costs of harambee schools increases total costs by only 9.2 percent, which does not measurably reduce the rate of return. There is, however, a gap between the private and social returns to government schooling because the subsidy per pupil in that system is far from negligible. Adding government subsidies onto private costs increases total costs by 133 percent. The result is that the social rate of return to government schooling is about 13 percent, whereas the private rate of return is 14.5 percent.

The gap between government and harambee schools in the social rate of return is less than the gap in private returns. Nevertheless, social returns to investment in government schools remain substantially higher than social returns to investment in private schools. This difference suggests that from the perspective of costs and benefits to the economy as a whole, not just to the individual or household, the government system is more cost-effective; output per shilling of input is higher in government than in harambee schools.[13]

The measured difference between the two systems in economic efficiency might stem from a difference in the quality of management. Alternatively, it might reflect increasing returns in the educational production function. Recall that total per pupil expenditures are substantially lower in harambee than in government schools. The returns to the additional 1,000 shillings per pupil per year spent in government schools may substantially exceed average returns. Educationalists generally presume that the learning curve, which relates inputs (on the horizontal axis) to skills acquired (on the vertical axis) has a logistic form; it rises rapidly at first and then more slowly. Kenyan secondary schools may be on the steeply sloped portion of such a curve, where a small increase in inputs yields a disproportionately large increase in outputs (see appendix I).

One implication of this efficiency differential for the assessment of government subsidies to secondary education is that a policy of reducing the subsidy per pupil by allowing the relatively unsubsidized harambee system to provide a disproportionate share of new secondary places would entail allocative inefficiency and cause some potential output to be forgone. Because of the higher total costs of the government system, however, the efficiency differential between the two systems is less than the 20 percent differential in labor productivity between government and harambee completers estimated by our wage function. If, as hypothesized, the educational production function is characterized by increasing returns, it may take only a small increase in the quality of harambee schools to reduce the difference between the two systems in gross social returns. Narrowing the gap between the two systems in total expenditure per pupil may therefore narrow the gap in social rates of return.

Just how robust are these assessments of the economic costs and benefits of reducing the subsidy per pupil to secondary education in Kenya? The adjustments of our estimates of relative private and social rates of return to government and harambee schooling that are summed up here and in table 15-4 provide a basis for judgment.

Adjusting for Credentialism

To what extent does credentialism account for the higher earnings of government than of harambee school completers? To what extent is the difference in earnings attributable to the greater skill of government completers, as indicated by their superior performance on the nationwide form 4 examination? To answer these questions we add to the wage function for those who had taken the form 4 examination a set of dummy variables, D, that signify the division of score on that examination. The estimated equation is presented in table 15-3 (column 3).

We see once again that examination performance has a powerful influence on earnings. The coefficients on the dummy variables increase monotonically and in large increments; all four are highly significant. The equation predicts that, when other characteristics are standardized, a form 4 leaver who placed in the first division will earn more than 100 percent more than a form 4 leaver who failed or did not sit the examination. Most striking is that adding examination performance to the explanatory variables entirely eliminates the influence of type of school on earnings. A comparison of columns 2 and 3 in table 15-3 shows that the coefficient on the harambee dummy, S_2, declines from -0.21 to -0.024 and is no longer statistically significant.

It appears that all of the difference in earnings between government and harambee completers is accounted for by differences in skill and that none is accounted for by credentialism; government and harambee completers with the same examination scores are predicted to earn the same wages. Therefore no adjustment needs to be made to our estimate of the rate of return to harambee schools. The rates of return after adjustment for credentialism are the same as the base calculations.

Adjusting for Wastage

As was seen above, the dropout rate from harambee schools (58 percent) is greater than that from government secondary schools (15 percent). Whether our estimates of rates of return have to be adjusted for differential wastage depends on whether gross returns to schooling are a linear or an increasing function of the number of years of schooling. If the returns function is linear, no adjustment need be made; under the assumption that the cost function is also linear, the rate of return per year of harambee school will be the same irrespective of the number of years completed, as will the relative rates of return to government and harambee schools.[14] If, however, returns per year of harambee schooling are lower for form 2 than for form 4 leavers, our base estimates of rates of return to harambee schooling will be biased upward. To assess whether the returns function is linear, we calculate the rate of return to two years of harambee schooling by estimating a wage function for form 2 harambee leavers and predicting the lifetime stream of net benefits, taking into account only two years of forgone primary wages and direct costs. The result of these calculations is a rate of return (private and social) of 6.5 percent, considerably less than the rate of return to four years of harambee schooling (9.5 percent).

To arrive at an adjusted aggregate rate of return to harambee schools, we weight the rates of return to forms 2 and 4 by the proportions who left harambee school at those levels. The adjusted rate of return is 7.5 percent (table 15-4), which widens the gap between government and harambee schools in private and social rates of return. There is no need to adjust the returns to government school because the dropout rate is so low.

Adjusting for Search Time

No wages are earned during the time spent searching for a job on completion of schooling.[15] We did not take account of this search period when we predicted the lifetime earnings of school leavers and calculated the base rates of return. Since there are large differences between harambee and government leavers in search time, relative rates of return may be biased by this omission. Among government form 4 leavers, 35 percent found wage jobs immediately as against 19 percent of harambee leavers. The average time taken to find a wage job for government leavers was 9.5 months, compared with 18 months for harambee leavers and 32 months for primary leavers. Because primary leavers take a longer time to find a job than do secondary leavers, the rates of return to both government and harambee schools are higher when an adjustment for search time is made than in the base calculation, but the returns to government schools rise more.[16] Therefore the gap between government and harambee schools in both private and social rates of return is widened by the adjustment.

Adjusting for Selectivity of Government Schools

We have confirmed that the difference between government and harambee leavers' wages arises from differences in cognitive skill. How much of the difference in cognitive skill is attributable to the higher quality of government schools and how much to the higher achievement of government school entrants at the start of secondary schooling and to their higher ability and socioeconomic background? If, to take an extreme case, all of the difference in skill were attributable to the selectivity of the government system, there would be no gap between the two systems in either gross private or gross social returns. Because of differences in costs, net private returns would still be higher in the government system, but net social returns would actually be higher in the harambee system.

We attempt to answer this question with regard to socioeconomic background; we cannot answer it with regard to cognitive skill at the beginning of secondary school because we do not have the necessary data. We were able to show for a subsample of form 4 leavers that there is no significant difference in ability between government and harambee school leavers. Family background may, however, be partly serving as a proxy for differences in achievement at the start of secondary school. Table 15-5 presents probit estimates of the following simple educational production function for form 4 completers:

$$\text{(15-2)} \qquad \text{Prob}(H = 1) = \Phi(\mathbf{X}'\beta)$$

where H is a dichotomous variable that takes the value 1 where the individual obtained a high score (division 1 or 2) on the form 4 examination. The vector of exogenous variables, **X**, includes F_i, the family background dummies; S_i, the dummies for type of school; and, to capture the cohort effect, A, the age of the worker. Φ is the cumulative-unit normal distribution function.

The three coefficients on the family background variables are significantly positive. They indicate that the probability of attaining a high score increases monotonically as the educational level of the student's parents increases. Nevertheless, the coefficient on the harambee dummy (S_2) is of larger absolute size and is more highly significant than the coefficients on any of the family background variables. The predicted probabilities, also shown in the table, more clearly illustrate these findings. In both the government and the harambee systems there is considerable vari-

Table 15-5. *Educational Production Functions of Performance on Examinations, Kenya*

			Probability of attaining high score[a]	
Independent variable	Coefficient	Parents' education	Government completer	Harambee completer
F_2	0.337	F_1	0.34	0.06
	(2.1)	F_2	0.47	0.11
F_3	0.539	F_3	0.55	0.15
	(3.5)	F_4	0.71	0.27
F_4	0.979	Average[b]	0.47	0.10
	(4.3)			
S_2	−1.159			
	(4.9)			
S_3	−0.903			
	(4.9)			
S_4	0.153			
	(0.5)			
A	0.010			
	(0.5)			
Constant	−0.699			
χ^2	78.2			
N	496			

Note: A, age. For definitions of other variables, see notes to tables 15-2 and 15-3.

a. The probability that $H = 1$ is the area under the standard normal curve between $-\infty$ and $\mathbf{X'B}$. Probabilities are predicted for individuals with mean age.

b. Averaged over all family background groups, with weights equal to mean family background for sample.

ation in performance on the form 4 examination by family background. The impact of type of school on the probability of attaining a high examination score, however, appears to be still larger; it is nearly five times higher for government leavers (0.47) than for harambee leavers (0.10). For reasons discussed above, the composition by family background of the two secondary systems is not greatly different. Therefore the effect of family background on performance in school is unlikely to have a large effect on the difference between government and harambee leavers in predicted cognitive skill levels and thus in predicted wages and returns to secondary schooling. The results of simulating the returns to government and harambee schooling in the absence of government school selectivity by family background (table 15-4) confirm this point.[17] The gaps in private and social returns narrow only marginally.

In sum, although our adjustments are piecemeal, they do not give conflicting signals. Two of our four adjustments—for credentialism and for the selectivity of government schools—have little impact on the relative rates of return to government and harambee schooling. Both of the other two adjustments—for differences in length of job search and in wastage rates—widen the gap between government and harambee schools in private and social rates of return. The widening of the gap in private returns implies that our simulations with the base rate calculations underestimated the increase in user fees necessary to equalize private returns to investment in the two systems. It appears that 8,000 shillings a year would not be sufficient. The widening of the gap in social returns implies that allowing the harambee system to increase its share of enrollments entails somewhat higher efficiency costs than we had supposed.

Access to Government Schools and Family Background

To assess the effects on the distribution of school places of a reduction in the subsidy per pupil, we estimate a simple educational attainment function. With the use of binomial probit we obtain maximum likelihood estimates of the parameters in the following reduced-form equation:

$$\text{Prob}(G = 1) = \Phi(\mathbf{X}'\boldsymbol{\beta}) \tag{15-3}$$

where G is a dichotomous variable that takes the value 1 if an individual attended a government secondary school (and thus benefited from government subsidies) and 0 if he did not, and $\mathbf{X}$ is a vector of exogenous variables. Among the exogenous variables is a set of four dummy variables that signify the educational level of the individual's parents. In another specification of the educational attainment function, estimated only for individuals whose fathers were farmers, a variable for the size of the farm is included among the exogenous variables. $\Phi(\mathbf{X}'\boldsymbol{\beta})$ is the cumulative-unit normal distribution function.[18]

Table 15-6 presents estimates of our probit educational attainment function and the predicted probabilities of attending a government secondary school, by family background group. In column 1 of that table, estimated for the entire sample, the coefficients on the variables for parents' education are positive and increase monotonically. All are significant. As noted in table 15-2, the predicted probabilities of reaping the large private benefits from subsidies to government education rise sharply with parents' educational level.

Access to the government secondary system is meritocratic; selection is based largely on performance on the primary-leaving examination. The educational production function in table 15-5 suggests that the educational level of parents matters to performance in both high-quality (government) and low-quality (harambee) schools.[19] Although we have no direct evidence, there is a strong presumption that, when school quality is standardized, the educational level of parents is also positively related

Table 15-6. *Educational Attainment Functions for Government Secondary School Attendance, Kenya*

Independent variable	*Coefficient* (1)	(2)	*Probability of attending a government secondary school*[a]	
			By parents' education, from (1)	
F_2	0.261	0.181	F_1	0.16
	(2.9)	(1.2)	F_2	0.23
F_3	0.581	0.597	F_3	0.33
	(6.1)	(3.4)	F_4	0.51
F_4	1.042	0.743	By size of farm, from (2)	
	(6.1)	(1.3)		
B	0.176	—	1.5 acres	0.17
	(3.8)	—	3.5 acres	0.19
A	−0.043	−0.041	7 acres	0.19
	(8.1)	(4.6)	15 acres	0.21
Ac	—	0.010	25 acres	0.24
		(2.5)		
Constant	0.355	0.319		
χ^2	193.2	48.0		
N	1,650	539		

Note: *B*, born in Nairobi; *A*, age; *Ac*, size of farm. For definitions of other variables, see note to table 15-2. Figures in parentheses are *t*-statistics.

a. The probability that G = 1 is the area under the standard normal curve between $-\infty$ and X'B. Probabilities are predicted for individuals born outside Nairobi, at the mean age.

b. Probabilities are predicted for individuals with uneducated parents, at the mean age.

to performance in primary school.[20] Moreover, children of more educated parents are likely to attend above-average primary schools because of the concentration of educated parents and high-quality primary schools in urban areas.

Our second educational attainment function (column 2 in table 15-6) indicates that family wealth has an influence, independent of parents' education, on the probability of attending a government secondary school. The equation is estimated only for those workers whose fathers were farmers and includes as an independent variable a measure of the size in acres of the family farm. Although the coefficients of the variables for parents' education continue to be positive and to increase monotonically, they are reduced in both magnitude and significance in relation to column 1 in the table. The coefficient of the variable for size of farm is positive and significant. For children of uneducated farmers the predicted probability of attending a government secondary school is about 40 percent higher for those from farms of 25 acres than for those from farms of 1.5 acres. This relationship may indicate a nonmeritocratic element in the influence of family background on access to government secondary schooling.

The equations in table 15-6 measure the relationship between the socioeconomic status of the parents of the workers in our sample and the educational attainment of the workers. To confirm that the effect of family background is not merely a historical phenomenon, we also estimated by probit the relationship between the educational attainment of the workers and the probability that their children would attend a government secondary school. The results (not shown) for the younger two generations are qualitatively the same as those for the older two generations; the richer the family, the greater the likelihood that it will benefit from government subsidies to secondary education. Kenya is not unique in this regard. (For evidence of similar outcomes see Hansen and Weisbrod 1969 for the United States and Jallade 1974 for Colombia.) This outcome is especially perverse since in Kenya, as in many developing countries, much government revenue comes from regressive import and excise duties rather than from progressive income taxes (see Fields 1975).

Conclusions

The private rate of return to investment in secondary education is markedly higher for children who attend government secondary schools than for those who attend harambee schools. This is partly because of the lower private costs of government schooling and partly because of the higher gross returns. The latter phenomenon is the result of the higher level of cognitive skill of government school graduates. Moreover, there is a positive relationship between family income and the probability of reaping the subsidies to government schools that contribute to the difference in private rates of return. These findings provide the basis for efficiency and equity arguments for reducing the subsidy per pupil in government schools by selectively increasing user fees.

Our simulations indicate that it would take an increase in user fees of more than 8,000 shillings per student a year to equalize private rates of return in the two systems. The revenue potential of user fees in government schools is therefore substantial—more than 300 percent of the government's recurrent expenditures per student for secondary education. This figure is so large partly because in the relevant range the price elasticity of demand for government schooling appears to be so small. It must be emphasized, however, that in practice the revenue potential will be less than the amount indicated because some families are not able to borrow in formal credit markets to finance schooling. Nevertheless, a substantial proportion of students in government schools is from families that have the means to pay the cost of their children's education and would be willing to do so in the absence of a highly subsidized alternative. The willingness of relatively low-income families to pay high fees to send children to low-quality harambee schools that yield low private returns is evidence for this assertion.

Even substantial increases in user fees are unlikely to lead to underutilization of government schools. Nor would a reduction of the subsidy per pupil bring about a deterioration of school quality, as private funds would simply substitute for public funds, leaving expenditures per pupil unchanged.

Increases in user fees may give rise to inefficient changes in the composition of the student body of government schools and a reduction in the size of the secondary system as a whole. There is some reason to believe that the students from uneducated and poor backgrounds who are forced to withdraw from the school system because of the rise in fees will be the most able, since students who gain access to government secondary schools without having the advantage of educated parents are likely to be unusually bright. If the increases in fees are uniform, relatively bright but poor students may terminate their education and be replaced by less able students from higher-income families who would otherwise have gone to harambee schools.

To avoid this outcome, increases in user fees could be discriminatory. A need-based scholarship program could ensure that admissions decisions would continue to be based solely on meritocratic criteria. There are problems with such a program. If the criteria for awarding scholarships are too loose, the scholarship program will cost too much, and if the criteria are too tight, the government secondary system may lose students who would qualify on meritocratic grounds. Although the difficulties of assessing ability to pay should not be underestimated, this system is likely to distribute government subsidies more equitably than the current one. At present, the least needy have the highest probability of obtaining a subsidy.

One alternative to raising school fees and providing scholarships to the needy would be to raise fees and then provide all students with loans to finance the private costs of a government secondary education. This approach has the advantage of avoiding means tests. The disadvantage is that a program for repayment would have to be set up and administered, but Kenya's "pay as you earn" tax system could be utilized for this purpose.

Reducing per student subsidies by allowing low-subsidy harambee schools to satisfy an increasing proportion of the growing demand for secondary schooling has been a de facto policy of the Kenyan government for more than a decade. Our results suggest that, on grounds of allocative efficiency, the case for this approach is actually not as strong as the case for raising user charges in government schools. The difference between the two systems in social rates of return indicates that harambee schools are less efficient than government schools; that is, they raise worker productivity less per shilling of total expenditure. Government regulation of quality in harambee schools, together with small subsidies (in comparison with those given to government schools) for quality-improving purposes such as buying textbooks, hiring better-trained teachers, and reducing teacher-student ratios, may substantially decrease this difference. If so, the efficiency costs of allowing harambee schools to satisfy an increasing proportion of secondary enrollments may also decline. This would be the case if the difference in efficiency between the two systems were accounted for by the higher total expenditure per pupil in government than in harambee schools and by the position of secondary schools on that segment of the educational production function that is characterized by increasing returns.

Notes

1. Throughout, our analysis compares government with harambee schools and excludes other private schools. This is because of the heterogeneity of the "other private" category. A few of these schools are very good and very costly; most are poor in quality and low in cost. Thus this category would have had to be further disaggregated, but some data essential for such a breakdown were not available. The omission does not pose a serious problem, since it appears that in important respects harambee schools are representative of the larger group of low-cost private schools.

2. The mean annual earnings of the manual workers in our sample were about 9,500 shillings.

3. Predictions are made with the use of the wage functions presented in table 15-3.

4. In this model, an individual demands secondary schooling, provided that the expected present value of the net benefit is positive, and chooses the segment with the higher expected present value.

5. Government guidelines call for holding expenditures on education to no more than 30 percent of the recurrent nondefense budget. For 1981–83 the share was estimated at nearly 35 percent.

6. The probability is predicted at the mean age for those born outside Nairobi with the use of the probit functions presented in table 15-6.

7. If people are capital-constrained, a rise in fees may force them to withdraw from the government system despite the high returns to government schooling. When fees are lower in government than in harambee schools, this will mean complete withdrawal from the secondary system. When fees in government schools are raised above those in harambee schools, people who face capital constraints may be forced to switch to the harambee system even though the private returns are lower.

8. We also estimated a version of equation 15-1 in which the S_i interact with the other dependent variables, but we concluded, on the basis of F-tests, that this is not a superior specification.

9. We have shown that different cohorts of school leavers have different profiles because of changes in the education-occupation matrix that are associated with rapid educational expansion; see chapters 7 and 14.

10. We assume that the wages of primary leavers are an accurate measure of the opportunity costs of secondary leavers. If entrance to secondary schools is meritocratic, this measure of opportunity costs will be too low. Moreover, to the extent that government secondary entrants are of higher quality than harambee entrants, the opportunity costs of the former will be still higher.

11. The 6,372-shilling difference between the total cost of schooling—3,368 shillings a year—and the fee that could be charged, given perfect capital markets, would be a tax on educational expenditure.

12. This estimate ignores the general equilibrium effects of a rise in user fees. If people spend more of their income on education, they may spend less on other goods that the government taxes—which will have a negative impact on public revenues—or they may spend less on goods that are subsidized—which will have a positive impact on public revenues.

13. The actual cost of public money expended is greater than the nominal cost because of the administrative and efficiency costs of collecting public money via the tax system. Taking account of this factor would lower the social return to government schools. Similarly, since harambee schools are often built and supported with voluntary labor and other inputs that are not costed, the amount of private money spent on them may underestimate the resources used.

14. Strictly speaking, linearity of wages in education does not imply constancy in rate of return over education of different lengths because the length of the working life decreases as years of education increase. This is unlikely to be quantitatively important.

15. School leavers may obtain income from other sources during this period, but the survey does not yield estimates of such income.

16. The following procedure is adopted to take account of search time. To predict the lifetime wage profile for primary leavers, we impose zero wages in the first two years, a third of a year's wages for the third year, and the equivalent of wages for $(T - 2.7)$ years of experience in the Tth year. For government secondary leavers wages are zero for the first four years after primary school, 0.2 of a year's wages for the fifth year, and the equivalent of wages for $(T - 4.8)$ years of experience for the Tth year. For harambee leavers wages are zero for the first five years after primary school, half of a year's wages for the sixth year, and the equivalent of wages for $(T - 5.5)$ years of experience for the Tth year.

17. The simulation was conducted as follows: the equation for column 3 of table 15-3 was reestimated after we substituted for the disaggregated set of dummies the more aggregated examination score variable used in the probit educational production function. The scores, by type of school, that were predicted when family background was set at the sample mean were substituted into the wage function to predict, in turn, the respective earnings streams for the gradu-

ates from the two types of school. The simulation removes the part of the higher cognitive achievement and earnings of government leavers that is attributable to their more educated family background.

18. In this model the coefficients do not represent the marginal change in the probability associated with each independent variable as they do in a simple linear probability model. For heuristic reasons, therefore, the table shows the predicted probabilities for various representative groups.

19. For reviews of studies that have documented such a relationship in other countries, see Alexander and Simmons (1975) and Bridge, Judd, and Moock (1979).

20. Virtually all primary education is provided by the government; there is no equivalent of harambee schools at the primary level in Kenya.

Part VI

CONCLUSION

CHAPTER 16

Lessons and Applications

IN PART I WE SUMMARIZED our analysis and drew out its implications for policy. It is not our intention to summarize the summary. We believe, however, that both the methodology and the findings of this study have broader applications, and it is on these that we wish to reflect briefly here. In particular, we are concerned with the extent to which the results of this study can be generalized from Kenya and Tanzania to other developing countries. We also consider how our methodological approach—the generation and analysis of rigorously comparable microeconomic data sets for countries that constitute natural experiments—can be applied to other country groups and can contribute to the study of the economics of education in developing countries.

Consider a few of the general conclusions from our analysis of the East African natural experiment. First, because secondary education imparts cognitive skills that increase labor productivity, investment in secondary education yields a high rate of return, and its expansion contributes substantially to economic growth. Second, increasing the relative abundance of workers with secondary education compresses significantly the educational structure of wages and as a result reduces the inequality of pay. Third, although the expansion of secondary education is likely to increase opportunities for children from poor families and thereby both equalize the distribution of secondary places and increase the incomes of those children in comparison with the incomes of their parents, it will do little to improve their position in the socioeconomic hierarchy.

It is possible that these findings do not apply to other developing countries. The outcomes from educational expansion may be different elsewhere for either of two reasons.

1. Parameters may differ; that is, the underlying relationship between educational expansion and outcomes may vary among countries because of, for example, differences in the skill intensity of production or in the culture and social structure of the societies. To illustrate, the wage compression associated with educational expansion might induce a countervailing reaction in the form of institutionalized wage structures, and the distributional benefits of expanding secondary education that we have

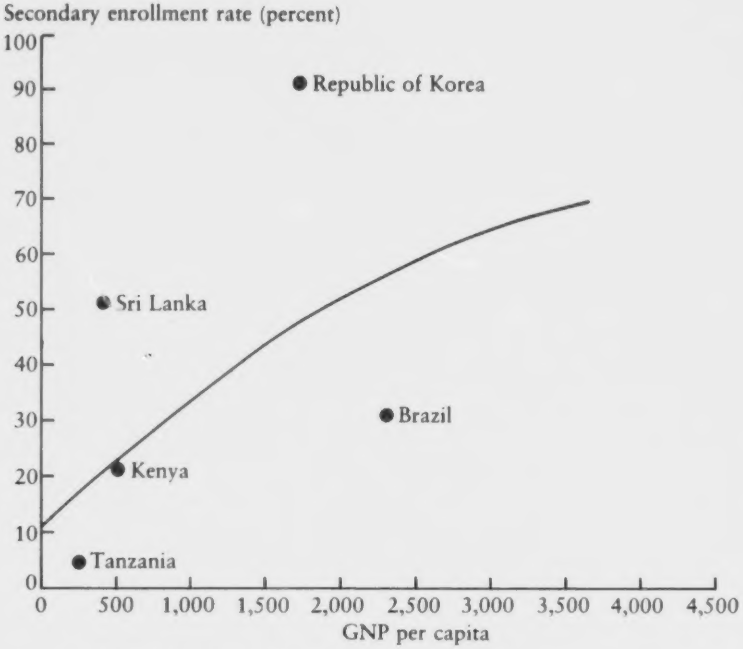
identified in Kenya and Tanzania might not be realized. Where the social returns to education have thus been driven down but the private returns, and therefore the demand for education, have remained high, the phenomenon known as the "diploma disease" is said to flourish.

2. The parameters may be similar, but such variables as the size and quality of educational systems may differ. For example, Sri Lanka's per capita income lies between the incomes of Kenya and Tanzania, but its secondary enrollment ratio exceeds 50 percent—more than twice the level one would expect for a country at that income level on the basis of the observed income-enrollment relation across countries and much higher than in either Kenya or Tanzania. If the parameters are similar, we would predict that the social returns to secondary education would be much lower in Sri Lanka than in Kenya and Tanzania because of diminishing returns to cognitive skill and perhaps because of a reduction in the quality of education as a result of rapid expansion. Examination of the natural experiment afforded by Sri Lanka in comparison with Kenya and Tanzania would allow us to assess how successive increments to the relative supply of secondary education beyond the range considered in this book would affect productivity and equity in low-income countries.

Another variable that could affect the outcome of educational expansion is per capita income. For example, the structure of production in middle-income countries differs markedly from that in low-income countries. We would expect the skill intensity of production to rise with per capita income, and this could have implications for the consequences of educational expansion. The per capita income of Brazil is more than five times that of Kenya, yet its secondary enrollment ratio in 1981 was only 32 percent, whereas Kenya's was 19 percent. Given similar parameters, we would predict that the educational structure of wages would be much less compressed in Brazil than in Kenya, and any greater skill intensity of labor demand would accentuate this effect. Similarly, we would expect the productivity benefits of educational expansion to be high. This suggests that the findings of our analysis can be generalized from Kenya and Tanzania to middle-income countries such as Brazil. A possible difference in parameters—the large provision of vocational training by employers and the government in Brazil—would qualify this prediction; the emphasis on such training may be an attempt to overcome the shortage of cognitive skill by substituting vocational skills.

Brazil lies well below the line that describes the cross-country relationship between per capita income and the secondary enrollment ratio (figure 16-1). The Republic of Korea, which has a similar per capita income, lies well above the line; its secondary enrollment ratio in 1981 was 85 percent. Yet economic growth in both countries has been impressive. This suggests that the relationship between skill acquisition and labor produc-

Figure 16-1. *Secondary Enrollment and Per Capita GNP in Selected Countries*



Note: The curve is based on the function

$$\underset{}{S = }\underset{(3.04)}{8.5647} + \underset{(8.54)}{0.02864Y} - \underset{(-5.53)}{0.000003Y^2}$$

where S is the secondary enrollment rate as a percentage and Y is GNP per capita in dollars. The figures in parentheses are t-statistics, $R^2 = 0.627$, and $F\ (2.74) = 64.85$. The data, for seventy-seven low-income and middle-income developing countries, are from World Bank (1985).

tivity does not hold with equal force in middle-income and low-income countries. Alternatively, the rapid expansion of vocational training in Brazil suggests that in middle-income countries it is not sufficient to focus on formal education when examining the consequences of human capital accumulation. Brazil is characterized by an unequal distribution of earnings, and Korea is noted for its relatively low degree of inequality in the labor market. This is consistent with the prediction suggested by our results—that the relative abundance of educated labor in Korea would bring about greater compression of the educational structure of wages there than in Brazil.

Our study of Kenya and Tanzania suggests that the marked difference between Korea and Brazil in education policy will have little impact on intergenerational mobility. The distribution of secondary education is undoubtedly more equal in Korea, but if our model applies, children of better-educated parents will be disproportionately concentrated in the upper half of the distribution of cognitive achievement on completion of secondary education. This in turn would give them an advantage in the competition for access to higher education and in the labor market, thereby preserving the position of the educated elite from one generation to the next. A qualification is in order: in Kenya and Tanzania education is virtually the only means of access to the top of the socioeconomic hierarchy, but in Latin America and East Asia, where physical capital and financial wealth are more abundant and often concentrated, socioeconomic success may depend more on the transmission of these forms of wealth or on the access they provide to higher education irrespective of academic achievement.

Although our ability to generalize our findings in East Africa may be limited, we are confident that the exploitation of other natural experiments would lead to sounder generalizations about the relationships between education and development. The best natural experiment is one in which the comparator countries are as similar as possible in many respects but differ markedly in the aspects being studied. A series of natural experiments, illustrated in figure 16-1 by the set of countries discussed above, would permit generalizations of the sort we are seeking. In Kenya and Tanzania, where most postprimary leavers have been absorbed into urban wage employment, it was possible to confine the research instruments to the urban wage sectors. In the other countries mentioned, the same set of questions probably requires research instruments that also cover the urban informal sector and the rural sector.

In seeking to discover uniformities in economic behavior as they relate to education by comparing economies which differ either in income or in educational level but not in both, we would be extending a well-established mode of cross-country analysis that includes the work of Kuznets (1965) and Chenery (1979). Our comparative approach, however, is much more disaggregated; our focus is more exclusively on education, and our sample contains fewer countries. Although greater disaggregation necessarily involves a smaller number of countries and some loss of generality, it permits the rigorous testing of more detailed hypotheses and more direct application of results to policy.

Our small-sample comparison is in the tradition of the comparative studies of industrialization by Balassa and others (1971), Bhagwati (1978), Krueger (1978), and Little, Scitovsky, and Scott (1970). It differs from such studies not only in its emphasis but also in its sources of data. The data requirements for an in-depth analysis of the relationships between human capital accumulation and labor productivity, income distribution, and intergenerational mobility are substantial. The only way to satisfy these requirements is to administer specially designed sample surveys in each country and thus generate precisely comparable microeconomic data sets. This combination—the comparison of countries that constitute natural experiments and the rigorous analysis made possible by survey data—may prove fruitful not only for the economics of education but also for the study of other issues in the economics of developing countries. It has potential application wherever there is a need to examine the influence of national policies by means of microeconomic data analysis.

APPENDIXES

APPENDIX A

The Surveys: Coverage, Sampling, Procedures, and Some Cautionary Tales

OUR OBJECT IN THIS APPENDIX is to persuade the reader that our data are reliable by explaining how the survey was designed and the information gathered. In addition, our methods may be helpful to researchers who are considering the use of sample surveys to generate primary data. The questions that our research addressed could not have been answered without generating new data sets that contained information on representative samples of individual workers. Survey design and sampling procedure are rather neglected in the training of most economists; such activities have too often been regarded as more within the province of sociologists. But the quality of economic research such as ours depends crucially on the design and implementation of the survey. The issues we wanted to explore gave us a fairly clear set of objectives for our fieldwork and data requirements. This appendix describes how, in the best economic tradition, we set about maximizing those objectives, subject to the triple constraints of finance, researchers' time, and the logistic problems typical of most developing countries.

There were times when we regretted our relative innocence about survey work in developing countries. For those readers intrepid enough to undertake similar field-intensive research, this detailed account of our experiences may therefore be of particular interest. Figure A-1, which shows the sequencing and timing of the many activities involved, may be a useful aid in planning a survey. A realistic vision of what is entailed in fieldwork in developing countries suggests that careful planning is necessary but not sufficient and that a robust sense of humor is essential.

The Pre-Survey Field Trip

Within two months after securing funding for the project, the principal researchers made a preparatory field trip, spending about eight man-

Figure A-1. *Survey Schedule*

	EAST AFRICA	WASHINGTON, D.C.	OXFORD
1979			
March		Draw up preliminary plans • Issues	
April		• Countries • Research design	
May			
June		Submit research proposal Conclude agreement on funds	
July	Make preparatory field trip		
August	• Secure government support • Select sample		
September	• Design and pretest questionnaire • Resolve logistical problems		
October	• Collect background information on labor markets and political economy	Review, revise, and precode questionnaire	
November	*Kenya* (field supervisor) • Select interviewers	Have tests designed (Princeton) Translate questionnaire	

December	• Send letters to firms • Arrange transport • Train interviewers	Typeset and print questionnaire	
1980			
January	KENYA: SURVEY		Check and code Kenya questionnaires and prepare for punching
February	*Tanzania* (field supervisor) • Select interviewers	Write report on survey Assess Kenya survey	
March	• Send letters to firms • Arrange transport	Finalize and print Tanzania questionnaire	Airfreight Kenya questionnaire to Washington
April	TANZANIA: SURVEY	Punch and verify Kenya data	
May	Check Tanzania questionnaires		Code Tanzania questionnaires and prepare for punching
June		Check data; conduct "wild code" and consistency checks	Airfreight Tanzania questionnaires to Washington
July		Punch and verify Tanzania data	
August		Begin descriptive work	
September		Regroup and refine variables; define new variables	
October		Begin data analysis	

weeks in Kenya and about five in Tanzania. There were five main tasks: to obtain the approval and support of the two governments; to select the establishments to be surveyed; to design and pretest the questionnaires; to resolve various logistic issues regarding the administration of the surveys; and to gather background information and data on labor market trends and performance and on the political economy of educational expansion and wage determination in Kenya and Tanzania.

Government support was crucial to the project. In both Kenya and Tanzania research of this sort must be approved by the government. In addition, we expected that a government request for cooperation by the establishments sampled would improve the response rate. The ministries that we decided to approach were Finance and Planning and Education in both countries and Manpower Development in Tanzania. We included the ministries of Finance and Planning because of their reputation for relative impartiality on educational sector issues, for efficiency, and for influence on policy and because of their close relationship with the statistical offices. Representatives of the World Bank in each country wrote on our behalf to the heads of the ministries of Finance and Planning—the permanent secretary in Kenya and the principal secretary in Tanzania—and gave them brief written descriptions of the proposed research. Team members then met government representatives, who agreed to write letters of introduction to be sent to the employers whose participation was required. We emphasized the potential usefulness of our research for policy, and it was this aspect that particularly interested the government officials.

The director of the bureau of statistics in each country gave permission for the team to use an official list of establishments as a sampling frame. The establishments were selected on criteria that are explained below. Even with the help of official statisticians, selection was a tedious and time-consuming task. The existing lists of establishments were not complete, and in some cases the information we needed to stratify our sample by establishment size was missing.

Preparation of the questionnaire benefited from the fact that one of the authors (Sabot) had conducted similar research in Tanzania ten years previously. In both countries the questionnaire was discussed with social scientists and educationalists, whose knowledge of local institutions and conditions was useful. A small pilot survey led to some changes in the questions and helped us decide on the answer categories to be used in precoding the questionnaires.

It was essential to find someone in each country who would be on the spot for two months before the survey, during the survey itself, and for about a month afterward. The research team could spend only a limited time in the field, and many planning and follow-up tasks had to be completed. In Tanzania a doctoral student who had worked for several years in Tanzania and who spoke Kiswahili was chosen as the principal administrator. It was arranged that he be based at the Economic Research Bureau of the University of Dar es Salaam. Our principal researcher in Kenya was a visiting academic at the Institute of Development Studies of the University of Nairobi who had spent several years conducting research in Kenya. This affiliation with the universities was important to the success of the survey. Because of the close liaison we established with them, we gained a base for our operation, help in recruiting university students as interviewers, and, in one case, transport facilities.

Several other practical tasks were tackled. The establishments to be visited were located on large-scale maps of the cities to facilitate the complicated logistics of transport planning. Arrangements were made for the fleet of vehicles necessary for transporting the researchers and interviewers during the survey.

As part of the background work on the political economy of educational expansion, wage determination, and the operation of the labor market, officials and academics were interviewed in both countries. Published data were obtained, and arrangements were made with the bureau of statistics in each country for access to data generated by other surveys.

Survey Coverage and Design

An establishment-based two-stage random sample survey, stratified by sector and establishment size, was carried out in the capital city of each country. The Nairobi survey was done in January 1980 and the Dar es Salaam survey in April 1980.

The Sample Universe

The choice of an establishment survey rather than a household survey requires some explanation because of the limitations in the coverage of data derived in this way. In particular, workers outside formal wage employment are not represented in establishment-based surveys. But the nature of the data to be collected made a survey of establishments rather than households preferable, for six main reasons.

- Most important, an establishment survey is the natural source of data for a project that is concerned with employment and the incomes generated by employment. The principal concern of our study was with adjustments in the labor market brought about by growth in the supply of workers with secondary education in the 1960s and 1970s. During this period nearly all of those with postprimary education were absorbed into urban wage employment.

- A much larger household survey would have been necessary to yield as many as 1,700 employees.
- Interviews would have had to have been conducted at night, and most people are more eager to interrupt their work than their dinner. Such considerations, other economies of scale, and more readily available sampling frames make establishment surveys less costly to administer.
- Data on wages and on occupation are likely to be more accurately collected from an establishment-based survey than from a household-based survey because confirmatory information can be obtained directly from the employer. The enquiry therefore does not rely solely on the recollection of the employee, and answers are much more easily checked and elaborated when information is being collected simultaneously from a number of employees within the same establishment.
- Characteristics of the employer are sometimes relevant variables in the relationships under investigation and are better collected from establishments.
- The surveys would be comparable with a 1971 establishment-based survey of about 1,000 Tanzanian wage employees in the manufacturing sector.

Because rural workers and the urban self-employed and unemployed were excluded from the survey, we were unable to explore the impact of education on, for example, decisions about participation in the labor force and the probability of unemployment. But economics is always about choice, and, given our objectives, the limitations were not too confining.

The surveys were conducted only in the capital cities because of survey efficiency and cost, because of the economic dominance of the capitals, and because previous labor market survey work in Tanzania had suggested that the capital adequately represented urban areas with respect to relevant wage employment characteristics (Sabot 1979). Sabot found that the relative percentage of migrants and city-born persons and the age on arrival of migrants were the same in Dar es Salaam as in the six next largest towns considered together. His earnings function analysis showed that there was no substantial difference in the level and structure of wages between the capital city and the other principal towns.

The Questionnaire

CONTENT. The questionnaire, which is reproduced in appendix B, contains several sections on personal characteristics, family background, respondents' education, rural-urban links, education of children, earnings, training, employment experience in the establishment, and previous employment experience. Not all sections were relevant to all workers. In addition, reasoning ability and cognitive skill tests were administered to a subsample of respondents. These tests are explained and discussed in appendix C.

The questions about the worker's personal characteristics were asked first, in accord with normal interview conventions of politeness. These and the questions about family background, which came next, helped put respondents at ease and reassured them that the questions would not be difficult. The family background questions concerned parents' education, occupation, and landholding.

Detailed information on the respondents' own education included the type of schooling, details of certification, public examination results, postschool training, and trade tests. Perceptions of the value of education were elicited in the context of the workers' aspirations and intentions concerning their children's education. Questions on the education of the respondents' children (including data on costs) allowed a three-generation educational history to be put together.

It is difficult to collect accurate data on earnings. Respondents may deliberately misrepresent their earnings—perhaps overstating them to impress the interviewer or understating them as a precaution against income tax consequences. They may fail to understand the exact nature of the information that is wanted. Should gross or net earnings be reported? Should nonpecuniary benefits be included? What of income from other sources? The survey asked for the amount of the last pay packet and specifically about each of the components of the remuneration package: bonus payments, overtime payments, tax and other deductions, and housing, pension, transport, and medical benefits. As a check on consistency the same information was elicited from employers where it was readily available. Despite our care, interviewers were not always able to record consistent figures. Some workers knew what their take-home pay had been, but others gave a gross figure. We were able to construct a consistent net income variable afterward by using the data on deductions and benefits and the information provided by some employers and by comparing the answers of workers in the same establishment. The layout of the earnings question was modified somewhat in the Tanzanian questionnaire to reduce the difficulties encountered in Kenya.

Questions on employment experience in the current establishment concerned how the job application had been made, the details of any training given, changes in wages, status, and skill level, and the relationship between the worker's education and the educational requirements of the job. Details of the worker's employment history were gathered. Questions were asked about the duration and nature of previous jobs, activities while out of wage employment, and reasons for leaving jobs.

The occupation of the respondent was described with regard to both current and previous employment. The classification of occupation is discussed in detail in appendix E.

The questions on rural links covered the size of landholdings, inputs of time and money, remittances and how they were used, and whether respondents planned to return to a rural area. Migrants were asked about their first income and first job search in the city.

DESIGN. According to Casley and Lury (1981, p. 92), "There is no doubt that questionnaire design is often the worst executed stage of survey preparations." The questionnaire is the crucial medium by which data are communicated from respondents to the computer, and its design must minimize the "noise" that can distort the process.

Our questionnaires were printed in both English and Kiswahili. They were translated from English into classical coastal Kiswahili by a Kiswahili speaker in Washington, D.C., and were translated back by another person to check that the original sense had not been changed. Some later adjustments had to be made to the questionnaire for Nairobi, where a more colloquial Kiswahili tends to be spoken. Respondents could choose which language to use in interviews.

We attempted to phrase the questions in a clear and simple way so that the respondents were not in any doubt as to what was being asked. The pilot survey conducted during the field trip was helpful in revealing and eliminating ambiguities and unfamiliar terms.

Particular care was taken with the layout and appearance of the questionnaires, for the sake both of the interviewers and of data quality. Casley and Lury (1981, p. 92) are emphatic about this:

> [The interviewer] is expected to produce results of a high standard in arduous conditions, and can legitimately expect that some attention is paid to his convenience and that his working materials are of reasonable quality . . . Many apparently minor, but actually important, details require concern for the enumerator's convenience, and more than repay the time and effort taken by leading to better quality . . . data.

The questionnaires were typeset and were printed on good-quality paper. The result was more impressive, neater, and more easily read than a typed and duplicated copy would have been. The difference in quality is well worth the additional cost that printing may involve, but if the print run is large, the difference in cost is unlikely to be a consideration. In general, printing on only one side of the paper is preferable, but we decided to print on both sides to reduce bulk and air freight charges. We did not look for any false economies in layout, since we were mindful that "a cluttered, badly laid out appearance . . . will almost certainly lead to poor recording" (Casley and Lury 1981, p. 91). Adequate space was allowed for writing the answers and for any additional explanatory remarks that might prove necessary.

The questions were precoded; that is, all of the anticipated answers to each question were listed and were assigned numbers so that interviewers could mark the appropriate number rather than having to write out an answer. An extra category, "other," was generally included for unanticipated answers. If this was used, the interviewer had to explain what it represented so that additional codes could subsequently be created where they proved relevant. Boxes for recording the coded answer were provided to the right of each question. The layout and precoding saved time in the preparation of the data, reduced coding errors, and minimized problems with reading interviewers' handwriting. The precoded categories helped to avoid vague and imprecise answers and improved the consistency of the data.

Sample Selection

The Sampling Frame

The sampling frame provided by the government bureau of statistics was the full list of establishments in each capital city, compiled for the annual *Enumeration of Employees* in Kenya and the annual *Survey of Employment and Earnings* in Tanzania. In principle, all employing establishments with fixed addresses, in both the private and the public sectors, were covered. Very small employers were likely to be underrepresented because they sometimes have no fixed address and because many are transient and are poor correspondents. Our one amendment to the sampling frame was that we decided to exclude establishments that employed fewer than five people, since their small share in total urban employment did not warrant the significant burden that their inclusion would add to the survey.

The most recent list of establishments in each country was for 1978. Returns submitted by establishments in the previous two years were also available. In neither case was the sampling frame complete. Exact sampling procedures differed between the two countries depending on the particular problems of the incomplete sampling frames and the form in which information was available.

In Tanzania nonresponse to the 1978 employment survey by firms on the list of establishments was a high 45 percent, which had serious implications for official employment statistics. To cope with the additional sampling problems this posed, we drew a 10 percent random sample of all listed establishments, including the nonrespondents, to use as our sampling frame. Since we were stratifying by establishment size, we had to know the size group for the establishments. Returns submitted in 1977 or 1976 by some of the 1978 nonrespondent establishments sufficed. About half of the rest were contacted by telephone to confirm their existence and size. This minimized the number of establishments that had to be excluded from the sampling frame.

In Kenya 20 percent of listed establishments had not returned the 1978 census forms and were excluded from the sampling frame. A table was constructed of response rates by size group of the establishments that had reported in at least one but not all three years. Larger establishments (particularly those with over 300 employees) seemed to have a slightly lower response rate, but the relationship was weak, and correcting for it was not worthwhile. The exclusion of Kenyan nonresponders is unlikely to bias the sample to any extent. No direct information could be obtained on the size of establishments that had not responded in any of the three years, but the opinion of the Central Bureau of Statistics was that they were either very small or had ceased to operate.

The list of more than 10,000 Kenyan establishments was not stratified by size and did not list Nairobi establishments separately. Since the Nairobi establishments were classified by activity only, their size distribution had to be estimated from the national size distribution under the assumption that the size distribution of establishments within each activity was the same in Nairobi as nationally. The size distribution of establishments with between five and forty-nine employees was inferred in this way; actual size data for establishments with more than forty-nine employees were taken from the *Survey of Employment and Earnings* list.

Drawing the Sample

SAMPLING METHODS AND CONSTRAINTS. The sample in each country had to be large enough to satisfy tests of statistical significance on the inferences to be drawn from the data analysis and to yield adequate cell sizes when the sample was disaggregated into subgroups by several key variables simultaneously. We judged that a sample of 1,500 would be needed to permit reliable inferences and generalizations. Both of our samples exceed this minimum acceptable size. It seemed reasonable to interview more people from bigger establishments but unreasonable to interview more than sixty people in any one establishment. These constraints, and those of time and manpower, imposed a maximum number of about seventy establishments and 2,000 respondents.

There were constraints on completely random selection. So that intertemporal comparisons could be made, the Tanzanian sample included twenty-five manufacturing establishments that had been surveyed in 1971. Three firms with establishments in both countries were included to permit detailed intercountry comparisons of the composition of the work force and the structure of wages after we controlled for differences in products, processes, and the way in which skills are categorized. Civil service workers—from the Central Bureau of Statistics, the Ministry of Transport workshops, and the Ministry of Education headquarters—were included to ensure that a range of occupations was represented and that the employees were geographically concentrated. Employees from these ministries were mainly clerks, manual workers, and bureaucrats, respectively. In each country workers from the headquarters and workshops of two public utilities—the railways and the post and telecommunications corporation—were also included.

The samples were stratified on the basis of sector—that is, manufacturing, government, and other nonmanufacturing—and, except for government, on the basis of size, as measured by the number of employees, both regular and casual. Stratification by ownership sector was necessary because pay policies differ significantly between sectors. The small number of establishments in the highest size category and the importance of government in that group made it advisable to sample government separately.

The manufacturing sector was deliberately oversampled—it accounted for about one-half of each sample—to ensure a large enough number of manufacturing workers for time-series comparison with the 1971 Tanzanian data. Manufacturing was therefore sampled separately.

A two-stage random sample was drawn. Establishments were randomly chosen (with some exceptions in Tanzania, as explained below) at the first stage, and employees were then randomly selected within each establishment. Usually the firm management could supply a list of employees to use as a sampling frame. Where this list grouped workers by department or skill level, a rough-and-ready sort of stratification was possible. On occasion we simply had to pick workers from the factory floor. We tried to avoid bias in this selection, but with perhaps ten interviewers waiting for us, selection procedures had to be simple and quick. An observation by Casley and Lury (1981, p. 78) is relevant here: "We believe that there has often been too much preoccupation with minor subtleties of sample design, and that the relative weight given to practical survey problems has been far too slight."

One sort of practical problem that Casley and Lury perhaps did not envisage was the unexpected exposure to the elements that we experienced while sampling in Tanzania. The roof of the Central Bureau of Statistics had been partly removed in the course of being replaced. This left us at the mercy of the elements and necessitated occasional desperate defensive clutches at our piles of papers.

SAMPLING DETAILS FOR EACH COUNTRY

- *Kenya.* After the number of employees to be sampled from each establishment-size category in each sector was known, it was necessary to decide on the number of establishments from which the respondents would be drawn. This required decisions on the ratio of respondents to employees within each sampled establishment—that is, on the sampling fraction. Once the sampling fractions had been decided, the establishments with fewer than 200 employees were drawn randomly from the alphabetical list. Random selection was ensured by the following procedure. The Kenyan list covered 1,100 pages. If twenty-five establishments of a size group were required, the first establishment listed on the twenty-second page that was of the desired size and had responded to the most recent official census of establishments was selected, and then the first such establishment on every forty-fourth page thereafter was chosen (1,100/25 = 44). The larger establishments (more than 200 employees) were listed separately by size group. If one-sixteenth of the group was required, the eighth establishment and every sixteenth establishment thereafter were selected. If a selected establishment was a nonresponder, the next listed one was substituted.

This produced a short list from which the final sample of establishments was chosen. The sampling fraction dictated the number of employees to be selected from each establishment. Establishments were added until the desired sample size had been reached. For example, 115 workers from Kenyan nonmanufacturing establishments with 20–49 workers were wanted. With a sampling fraction of 0.75, the first five of the six short-listed establishments provided 117 workers. In some cases the proposed sampling fraction would have yielded a sample rather different in size from that planned, since increments to the sample were discontinuous. In such cases the sampling fraction was revised to yield an actual sample equal to that desired. For establishments of 500 or more employees the sample was set at 60, and so the sampling fraction was not used.

Table A-1 shows the sampling fractions and establishment sample size—that is, the average number of respondents expected from each establishment. Table A-2 shows the number of individuals and establishments sampled at the second stage. The three government ministries are included with the nonmanufacturing establishments, although they were sampled separately.

Table A-1. *Establishment Sampling Statistics, Kenya*

Establishment size (number of employees)	*Sampling fraction*	*Average sample size (number of employees)*
5–19	1.00	9
20–49	0.75	23
50–99	0.40	28
100–199	0.30	41
200–299	0.20	49
300–499	0.15	55
500 or more	0.045	60

Table A-2. *Number of Respondents and Establishments Sampled, Kenya*

	Manufacturing			*Nonmanufacturing*		
	Number of respondents			*Number of respondents*		
Establishment size (number of employees)	*Desired*	*Actual*	*Number of establishments*	*Desired*	*Actual*	*Number of establishments*
5–19	57	45	3	128	94	14
20–49	99	89	4	115	51	5
50–99	137	147	5	83	65	3
100–199	109	111	3	123	117	3
200–299	58	58	1	98	75	2
300–499	61	59	1	110	111	2
500 or more	354	356	5	405	399	6
Total	875	865	22	1,062	912	35

- *Tanzania.* The manufacturing establishments selected in Tanzania were to include the twenty-five surveyed in 1971. Since these firms were all at least ten years old, the other manufacturing establishments were selected from those that began operating after 1971. The rate of growth of manufacturing employment in Dar es Salaam guided the decision on the proportions of the sample that were to be drawn from the 1971 survey establishments and from the new establishments. There were 23,411 manufacturing workers in 1971 and 26,500 in 1975. A rough estimate of the number in 1980 led to the choice of a ratio of 1 to 1.28.

The target sample size called for ten more establishments in the smallest size group and for three, two, and one, respectively, in each of the larger size groups. Metal Box (200–999 employees) and Tanzania Shoe Company (formerly Bata, more than 1,000 employees) were purposely added to the sample for comparison with Kenya. A third comparator enterprise, Tanzania Cigarette Company (formerly BAT), was one of the twenty-five visited in 1971. This left ten establishments of 5–49 employees, three of 50–199 employees, and one of 200–999 employees to be sampled randomly to complete the manufacturing subsample.

The ratio of public service employees to other nonmanufacturing workers was to be 300 to 700, corresponding to the proportions of employees in the public services and nonmanufacturing enterprise sectors recorded in Dar es Salaam in 1976. As in Kenya, three government ministries and two public utilities were included. Additional establishments in the other nonmanufacturing category were randomly drawn from the sampling frame.

In the second stage of the sampling the number of employees to be interviewed in each enterprise was decided. Seventy-five employees were to be randomly sampled from each of the three government ministries, and, to generate a large enough subsample, seventy-five employees were to be interviewed in each of the three comparator establishments. The rest of the employees were to be randomly sampled from the selected enterprises with the use of the sampling fractions shown in table A-3. The minimum and maximum conditions imply that all employees in an enterprise of 12 or fewer workers would be interviewed, that an establishment with fewer than 104 employees would provide 12 respondents, that one with between 104 and 480 employees would provide one-eighth of its employees, and that those with more than 480 employees would provide 60 respondents.

Table A-4 shows the planned and final samples, with government included in nonmanufacturing. The large discrepancies between the planned and actual samples in the 200–999 size groups arose because the Coca-Cola establishment was listed in the sampling frame as nonmanufacturing but was in fact a production plant.

The actual samples (which differed a little from the final planned samples of tables A-2 and A-4) consisted of 1,749 people in sixty-three establishments in Tanzania and 1,777 people in fifty-seven establishments in Kenya.

Table A-5 lists the establishments sampled in each country.

Conducting the Surveys

The Initial Contact with the Establishments

Once the sample had been selected, letters from the team and from the government ministry were sent to the establishments (figure A-2). The letters explained that a "study of the labor market consequences of educational expansion" was being carried out by the World Bank team with

Table A-3. *Establishment Sampling Statistics, Tanzania*

Establishment size (number of employees)	*Sampling fraction*	*Sample size (number of employees)*
5–49	1.000	Up to 12
50–199	0.125	Minimum of 12
200–999	0.125	Up to 60
1,000 or more	—	60

— Not applicable.

Table A-4. *Number of Respondents and Establishments Sampled, Tanzania*

	Manufacturing			*Nonmanufacturing*		
	Number of respondents			*Number of respondents*		
Establishment size (number of employees)	*Desired*	*Actual*	*Number of establishments*	*Desired*	*Actual*	*Number of establishments*
5–49	97	88	10	66	53	6
50–199	185	191	14	103	74	6
200–999	414	465	12	252	135	4
1,000 or more	330	327	5	405	416	6
Total	1,026	1,071	41	826	678	22

the support of the ministry and that the establishment had been randomly selected for inclusion. Cooperation was requested, and the establishments were assured that disruption would be kept to a minimum and that all information would be treated with complete confidentiality.

The letters were followed up by telephone calls to schedule visits. All the establishments agreed to participate in the survey. On a few occasions, because of confusing street numbering or poor directions, the team was unable to find the establishment to be visited and had to substitute other establishments from a list of reserves.

Training the Interviewers

In each country about thirty university students in the social sciences, mainly economics and educational psychology, were hired as interviewers. Two days were devoted to their training. The nature and purpose of the survey were explained in detail, and the importance of the interviewers' role in securing cooperation and accurate data was emphasized. Each item on the questionnaire was discussed, and the interviewers' comments led to a few last-minute changes in the questionnaire. The students administered the questionnaire to each other as practice, and the com-

Figure A-2. *Letter to Establishments Selected for the Survey, Kenya*

To Whom It May Concern

A team from the World Bank, comprised of Messrs. Bigsten, Collier, Hazlewood, Knight, Sabot, and various locally recruited interviewers, is engaged in a study of the labour market consequences of educational expansion in Kenya. As part of this study they are conducting a survey of wage employers and employees in Nairobi. Establishments were randomly selected from a complete list of employers in Nairobi. Yours is one of those to be included in the survey. The team wishes to interview you and a random selection of your employees.

This project has the support of the Ministry of Economic Planning and Community Affairs. I would be grateful if you would cooperate with the World Bank team. They have assured me that the interviews will be conducted with minimal disruption of your productive activities and that all information provided will be treated with strictest confidentiality.

Yours sincerely,

H. M. Mule
Permanent Secretary
Ministry of Economic Planning and Community Affairs

pleted forms were then carefully reviewed and mistakes discussed. The training period was short but intensive and seemed effective.

Administration of the Survey

The logistic problem of scheduling each day's work for the thirty interviewers and transporting them among establishments was daunting. There were some setbacks to our plans—for example, the Volkswagen "Beetle" that had been bought for the use of the principal administrator in Tanzania was out of action throughout the survey.

With practice, the five supervisors became more efficient in organizing the interviews within establishments and logistically planning each day's interviews. The researchers also acquired another skill—that of Third World taxi driver. The time constraint under which we operated added a lot of extra strain to an operation that would have been challenging even at a leisurely pace. It proved possible to complete all the interviews in three to four weeks in each country, but such pressure is not optimal and is better avoided if finances and the schedules of the researchers permit. The time necessary for day-to-day planning, for supervision, and for resolving logistic problems should not be underestimated.

Table A-5. *Establishments Visited*

Number	*Establishment*	*Size category*	*Type*	*Sample (number of employees)*
Nairobi				
1	Nairobi Food Products, Ltd.	1	M	7
2	Chai, Ltd.	1	M	19
3	Fulchard Manek and Brothers	1	M	19
4	African Retail Traders	1	N	5
5	Architectural Engineering Collaborative	1	N	9
6	United Dry Cleaners	1	N	8
7	Crowder Associates	1	N	5
8	East African Wildlife Society	1	N	5
9	Glad-Ak, Ltd.	1	N	7
10	Huruma Girls High School	1	G	3
11	J. J. Ruparel	1	N	6
12	Karen Butchery	1	N	10
13	K Meat Supply Company, Ltd.	1	N	6
14	Noor Electrical	1	N	9
15	Macharia Bar and Restaurant	1	N	5
16	Mbura Transport	1	N	10
17	Ramco Hardware	1	N	6
18	Anbee Ltd.	2	M	11
19	Haraka Hosiery Manufacturers	2	M	18
20	Kamco Engineering	2	M	33
21	Kirinyaga Works Ltd.	2	M	27
22	Central School	2	N	11
23	Central Tobacco Distributors	2	N	10
24	New Rwathia Night Club	2	N	7
25	Rambhai and Co.	2	N	10
26	New Tyres Enterprises	2	N	13
27	Kleenway Chemicals	3	M	21
28	General Printers Ltd.	3	M	40
29	Oshwal's Clothing Ltd.	3	M	22
30	Shah Timber Mart	3	M	40
31	Universal Garments Ltd.	3	M	24
32	NCR	3	N	23
33	Kirima Safari Hotel	3	N	20
34	Murdoch, McRae and Smith	3	N	22
35	Nairobi Flour Mills	4	M	33
36	East African Cables Ltd.	4	M	48
37	Intersilk Garment Manufacturers	4	M	30
38	Lion of Kenya Insurance	4	N	32
39	Nairobi Club	4	N	47
40	Livingstone Registrars Ltd.	4	N	38

Number	Establishment	Size category	Type	Sample (number of employees)
Nairobi				
41	Ideal Casements	5	M	58
42	Capital Construction Ltd.	5	N	23
43	Kenya Tea Development Authority	5	N	52
44	East African Fine Spinners	6	M	59
45	Standard Bank	6	N	52
46	Lalji Meghi Patel	6	N	59
47	BAT Ltd.	7	M	73
48	Metal Box Ltd.	7	M	81
49	Bata	7	M	75
50	Coca-Cola	7	M	61
51	Elliot's Bakeries	7	M	66
52	Kenya P and T Corporation	7	N	57
53	Kenya Railways CME workshops	7	N	60
54	Nairobi City Council	7	N	57
55	Central Bureau of Statistics (Ministry of Finance)	7	G	75
56	Ministry of Transport workshops	7	G	77
57	Ministry of Education	7	G	73
Total				1,777
Dar es Salaam				
1	Bombay Flour Mills	1	M	8
2	Eros Footwear	1	M	6
3	Parmar Tailoring House	1	M	6
4	Timbers Ltd.	1	M	5
5	Teena Garments Manufacturing Ltd.	1	M	16
6	Coast Region Carpenters Cooperative Society	1	M	10
7	Reliant Motors	1	M	5
8	Phillips (Tanzania) Ltd.	1	M	12
9	Zapata Spares and Services Ltd.	1	M	8
10	Burns and Braine (Tanzania) Ltd.	2	M	19
11	Gloria Bakeries	2	M	13
12	Kartar Singh and Harisingh (1974) Ltd.	2	M	13
13	Tanganyika Garments Manufacturing Company Ltd.	2	M	12
14	Leyland Albion (Tanzania) Ltd.	2	M	14
15	Kanvir Industries (Tanzania) Ltd.	2	M	16
16	Ekasa Garments Industries Ltd.	2	M	10
17	Auto Garage Ltd.	2	M	15
18	Construction Equipment (Division of UAC Tanzania) Ltd.	2	M	14

Number	Establishment	Size category	Type	Sample (number of employees)
Dar es Salaam				
19	Darbrew Ltd.	2	M	14
20	Riddoch Motors, East Africa Assemblies Ltd.	2	M	12
21	Wuasu Battery East Africa Ltd.	2	M	13
22	Bansons Enterprises	2	M	16
23	National Bicycles Co. Ltd.	3	M	28
24	Palray Ltd.	3	M	35
25	D. T. Dobie & Co. (Tanzania) Ltd.	3	M	30
26	Metal Box (Tanzania) Ltd.	3	M	75
27	Simba Plastics Co. Ltd.	3	M	32
28	Tanganyika Sisal Spinning Co. Ltd.	3	M	27
29	Tanzania Breweries	3	M	31
30	Garments Manufacturing Ltd.	3	M	25
31	National Engineering Co. Ltd.	3	M	41
32	Tanzania Portland Cement Company, Ltd.	3	M	63
33	Ubungo Farm Implements	3	M	21
34	Tanzania Shoe Company, Ltd.	4	M	77
35	Aluminium Africa Ltd.	4	M	60
36	Tanzania Cigarette Company, Ltd.	4	M	73
37	Kilimanjaro Textiles Corp.	4	M	58
38	Tanita Company, Ltd.	4	M	59
39	Babu Building Contractors	1	N	15
40	Tanzania Transcontinental Trading Company, Ltd.	1	N	5
41	Royal Restaurant	1	N	12
42	Central Automotive Agencies Company, Ltd.	1	N	5
43	Walji's Travel Bureau Ltd.	1	N	7
44	Donaldson and Wood Advocates	1	N	9
45	Ukonga National Hatchery	2	N	10
46	Tarrazzo Paviors	2	N	6
47	Express Construction Company, Ltd.	2	N	21
48	Hoechst Tanzania Ltd.	2	N	10
49	Norman and Dawbarn	2	N	11
50	Dar es Salaam College of National Education (Chuo Cha Watu Wassima Dar es Salaam)	2	N	16
51	State Mining Corporation	3	N	31
52	Dar es Salaam Water Supply	3	N	20
53	Builders (V. M. Chavas) Ltd.	3	N	42
54	Coca-Cola (Tanzania) Ltd.	3	N	57
55	Agence Maritime Internationale	3	N	42
56	East Africa Railway Corporation head office and chief mechanical engineers workshop	4	N	56

Number	Establishment	Size category	Type	Sample (number of employees)
57	P and T Corporation, head office and workshops	4	N	76
58	Tanzania Harbour Authority	4	N	72
59	Tropical Products Supply Company, Ltd.	2	M	10
60	Ministry of Works	4	G	72
61	Central Bureau of Statistics	4	G	72
62	Ministry of Education	4	G	68
63	Tartimbers	1	M	12
Total				1,749

Note: M = manufacturing; G = government; N = other nonmanufacturing. Size codes are as follows, by number of employees.

Nairobi		*Dar es Salaam*
1 = 5–19	5 = 200–299	1 = 5–49
2 = 20–49	6 = 300–499	2 = 50–199
3 = 59–99	7 = 500 or more	3 = 200–999
4 = 100–199		4 = 1,000 or more

The Interviews

Interviews were conducted in all sorts of places, including a noisy nightclub, busy factory floors, storerooms, company training centers, corporate boardrooms, and on the ground in a dusty courtyard in 110-degree heat. Almost all took place during working time, which may have contributed to the eager cooperation of employees that we experienced throughout.

Nonresponse was negligible. Most establishments were cooperative and helpful; a few were somewhat grudging. On one occasion the research team's first impression of an establishment was concentrated on the wrong end of the barrel of a gun. The establishment had been robbed the previous week, and the guard had evidently decided that hostile suspicion was the appropriate company policy toward strangers. Although patient negotiations were sometimes necessary, no employer refused to cooperate. Nor did employers refuse access to payroll records, although in some cases there was no time to extract information and in others records were inadequate. When feasible, the researchers conducted informal interviews with employers while the employee interviews were going on. Although the interviews with employers were fairly unstructured, they were to provide useful ideas and insights in the analysis of the surveys.

Workers were informed that the interviews held no possibility of personal gain. The only workers who showed any reluctance to be interviewed were some managers. Most seemed glad for the chance to talk about themselves. Indeed, the experience of this study (as of the classic Hawthorne productivity study) is that workers are pleased to have someone who is apparently in a position of authority take an interest in them and their opinions. The attitudinal questions, which are of dubious analytic value, may have served a purpose by eliciting this response. Workers who were somewhat suspicious at the start of the interview were, after ten minutes, generally thoroughly engaged in the process and unguarded in their responses. The reasoning ability test was viewed as a game, and the numeracy and literacy tests were accepted as a challenge.

The number of interviews completed by each enumerator per day increased rapidly during the first week. On the first day 130 interviews and six sets of tests were completed, well below the average necessary to meet our targets within the allotted period. On the fifth day 240 interviews and 45 sets of tests were completed. This marked increase in productivity was the combined result of improvements on two learning curves. First, the increasing efficiency with which the supervisors learned to plan and organize each day's work reduced the number of interviewers who were idle at any time during the day. Second, the time spent on each interview decreased as interviewers became familiar with the questions and with the detailed instructions concerning the alternative sets of questions to be asked of respondents with different characteristics.

The performance of the student interviewers was impressive. They learned quickly and followed instructions closely. They were rarely absent and were uncomplaining, whatever the circumstances. The explanation is not material incentives alone; they were paid the market wage, not a premium. Rather, they became engrossed in this opportunity to gain on-the-job experience relevant to their course of study. They established an easy rapport with workers in a wide variety of occupations. Sometimes the questions may have contributed to this: an attractive young secretary laughed when asked, "How many husbands do you have in Nairobi?"

Data Coding

From the Field to the Computer

On completion of the survey in Kenya the questionnaires were airfreighted to Oxford, where they were checked and the coding was completed. The only delay between Nairobi and Oxford was caused by customs officials at Heathrow, who were deeply suspicious of large boxes of printed paper, listed as having no commercial value but insured for 20,000 pounds!

As Casley and Lury note, "The maxim must always be to get the data 'clean' at as early a stage as possible—preferably in the field or, if not then, immediately on receipt in the office" (1981, p. 124). In Tanzania we arranged for some interviewers to continue working with the principal administrator after the survey, checking the questionnaires and completing all the coding except for difficult items such as occupation and earnings. This was done in Oxford by two of the research team to ensure consistency.

The coded and checked questionnaires were sent to Washington, D.C., where the data were punched and then repunched as verification. (With the advent of sophisticated data entry programs, card punching is now an outmoded technology.) The Statistical Package for the Social Sciences (SPSS) was chosen for its wide familiarity, easy use, clear table layout, and statistical adequacy for the more elementary analysis. Once the data were in the computer in the file structure required by SPSS, a "wild code" check was carried out to ensure that the values of each variable fell within the range permitted by the coding scheme. Consistency checks of improbable or impossible combinations of values on several variables were carried out, and extreme values of variables were checked for miscoding or mispunching. Even if these extreme numbers passed scrutiny, it was useful to be aware of them, since they could influence parameter estimates. Missing data were given a "missing value" code, and the affected workers were excluded as necessary during analysis. Since there were only a few such cases and they involved only a few variables, they did not cause significant sample attrition.

Weighting the Samples

The samples had to be weighted to correct for the underrepresentation of nonmanufacturing compared with the actual relative sector sizes in the economy. The *Survey of Employment and Earnings* definition of the public services sector in Tanzania was more inclusive than ours. We included only central government ministries, whereas the official definition was "public sector community, social, and personal services." In computing the weights to be used we had to make our demarcations of sectors consistent with published statistics by temporarily reclassifying a public educational institution in each country as public service.

Owing to practical exigencies, the actual sample proportions of different size groups within the manufacturing and other nonmanufacturing categories deviated somewhat from planned proportions, and a correction for this was incorporated in the weights. The weights were derived from the final sample proportion of a size-sector cell divided by its actual proportion in the population. Thus, if other nonmanufacturing establishments with between fifty and ninety-nine employees accounted for 15 percent of total employment in Nairobi but for only 10 percent of our Nairobi sample, the weight applied to this group was 15/10 = 1.5. If these "raw" weights had been applied, however, the sample size would have been changed. A correction factor was computed for the weights so that the weighted and unweighted samples would be the same size.

The Completed Data Tapes

New variables were created by aggregation, and simple cross-tabulations were run. The first results were generated about six months after the first interviews. As the descriptive analysis began, we continued to watch for unfeasible or suspect variable values. Thus the first analysis and the final checking continued simultaneously.

Much of the data analysis used SPSS subprograms, but other packages were also used. A copy of the data was transferred to the Oxford University ICL 2988 computer, and some of the computer work was done there. The weighting procedure of SPSS involves some randomness. If the weighting requires that the number of cases in some stratum be increased—say, by 25 percent—then one-quarter of the cases in the stratum are randomly selected to be included twice. The Oxford and Washington, D.C., data sets are therefore not necessarily exactly the same, but in no case do the (very slightly) different data sets produce other than trivial differences in results.

APPENDIX B

Sample Questionnaire for Employees, Tanzania Survey

THE FOLLOWING PAGES present a reduced facsimile of the employee questionnaire used in Tanzania. Questions are in both English and Kiswahili.

Employee Questionnaire

		REPLY	CODE
Employee Number	(1-4)		
Card number	(5)		1
Firm number	(6-8)		
Interviewer number	(9-10)		

I, Personal Characteristics

				REPLY	CODE
1	Sex:	Male	(11)		1
		Female			2
2	Ethnic group:	African	(12)		1
		Asian			2
		European			3
		Other			4
		No reply			9
3	Are you a citizen? Wewe ni raia?	Yes	(13)		1
		No	(13)		2
		No reply			9
	If no: How long have you lived in Tanzania? (years) Umeishi Tanzania kwa muda gani? (miaka)		(14-15)	(N/A)	00
4	How old are you? (years) Umri wako ni miaka mingapi?		(16-17)		
5	Are you: Hali ya ndoa:	a. Never married Hujawahi kuoa/kuolewa	(18)		1
		b. Married Umeoa/umeolewa			2
		c. Widowed Mjane			3
		d. Divorced Mmeachana			4
		e. Separated Mmetengana			5
		f. No reply Hakuna jibu			9

6. How many people in addition to yourself do you help support (regularly in money or kind) with you rearnings?
Pamoja na wewe, ni jumla ya watu wangapi ambao mahitaji yao yanatokana na mapato yako?

Husbands or wives, fully Waume au wake, yote	(19)		
Husbands or wives, partly Waume au wake, kiasi	(20)		
Children, fully Watoto, yote	(21-22)		
Children, partly Watoto, kiasi	(23-24)		
Other, fully Wengine, yote	(25-26)		
Other, partly Wengine, kiasi	(27-28)		

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II. Family Background

1. What was the highest level of education that your father received?
Baba yako amesoma mpaka daraja gani?

		REPLY	CODE
None Hakwenda shule	(30)		0
Primary Shule ya msingi			1
Secondary Sekondari			2
Other post primary (e.g. pre-service training) Zaidi ya shule ya msingi (kwa mfano mafunzo ya kikazi)			4
Post-secondary Zaidi ya Sekondari			4
No reply			9

2. What was his main occupation when you left school?
Alikuwa anafanya kazi gani wakati ulipoacha shule?

		REPLY	CODE
farmer mukulima	(31)		1
other self-employed kazi ya binafsi ya aina nyingine			2
manual wage-earner kazi ya ufundi wa mikona ya malipo			3
non-manual wage earner kazi ya kulipwa ya aina nyingine			4
business proprietor biashara yake binafasi			5
deceased amefariki			6
other *(specify)* kazi nyingine *(eleza)*			7
don't know			8
no reply			9

If farmer: When you left school about how much land did he farm?
Ulipoacha shule alikuwa analima shamba kubwa kiasi gani?

		REPLY	CODE
	(32-33)	N/A	00
hectares hekta			—
or acres au ektari			

If farmer: When you left school did he do *Ki barua* for others?
Ulipoacha shule alikuwa kibarua kwenye mashamba ya watu wengine?

		REPLY	CODE
	(34)	N/A	0
Yes			1
No			2
Don't know			3
No reply			9

If farmer: When you left school did others do *ki barua* for him?
Ulipoacha shule alikuwa ameajiri vibarua wa kusaidia shambani?

		REPLY	CODE
	(35)	N/A	00
Yes			1
No			2
Don't know			3
No reply			9

3. What was the highest level of education that your mother received?
Mama yako amesoma mpaka daraja gani?

		REPLY	CODE
none hakwenda shule	(36)		0
primary shule ya msingi			1
secondary sekondari			2
other post-primary (eg. pre-service training) zaidi ya shule ya msingi (kwa mfano mafunzo ya kikazi)			3
post-secondary zaidi ya sekondari			4
don't know			5
no reply			9

4. What was her main occupation when you left school?
Alikuwa anafanya kazi gani wakati ulipoacha shule?

		REPLY	CODE
farmer mkulima	(37-38)		01
other self-employed kazi yake binafsi ya aina nyingine			02
manual wage-earner kazi ya ufundi wa mikono ya kulipwa			03
non-manual employee kazi ya kulipwa ya aina nyingine			04
business proprietor biashara yake binafasi			05
deceased amefariki			06
other *(specify)* kazi nyingine *(eleza)*			07
housewife only mama wa nyumbani			10
don't know			08
no reply			99

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III. Education

1. What was the highest standard in primary school that you completed?
Darasa la juu kabisa uliofikia kwenye shule ya msingi ni lipi?

		REPLY	CODE
(39)			0
			1
			2
			3
			4
			5
			6
			7
			8
	no reply		9

2. Did you receive a primary leaving certificate?
Ulipata cheti cha kumalizia shule ya msingi?

		REPLY	CODE
(40)	Yes		1
	No		2
	No reply		9

If no primary schooling, proceed to Question 4a.

3. What type of primary school was it? (If more than one, last school)
Shule ya msingi uliyosoma ilikuwa ya aina gani? (Kama ni zaidi ya moja, taja uliyosoma mwishoni)

		REPLY	CODE
(41)		N/A	0
	a. Government Serikali		1
	b. Private		2
	c. Mission Iliyoendeshwa na makanisa		3
	d. No reply		9

4. Did you have any education or pre-service training after primary school?
Baada ya kumaliza shule ya msingi uliendelea na masomo au ulipata mafunzo ya kukuwezesha kupata kazi?

		REPLY	CODE
		N/A	
(42)	Yes		1
	No		2
	No reply		9

If no: *preceed to Question 4a.*
If yes: Which of the following types did you have? *(indicate the order)*
Ulipata elimu ya aina gani kati ya zifuatazo?

		REPLY	CODE
(43-44), (45-46) (47-48) & (49-50)		N/A	00
	a. Government secondary Sekondari ya serikali		01
	b. Self-help secondary Shule ya sekondari ya kujitegemea		02
	c. Private secondary Sekondari ya "private"		03
	d. Technical secondary Shule ya sekondari ya ufundi		04

		REPLY	CODE
e.	Teacher training (non-university) Shule ya ualimu		05
f.	University Chuo kikuu		06
g.	Technical College Chuo cha ufundi		07
h.	Trade School Shule ya ufundi		08
i.	Craft School Shule ya kazi za mikono		09
j.	Folk development College *(specify length of course)*		10
k.	Government-run pre-service training institution *(specify)* Shule ya mafunzo (ya vijana) kabla ya kuanza kazi, inayoendeshwa na serikali (taja)		11
l.	Employerrun pre-service training school *(specify)* Shule ya mafunzo kabla ya kuanza kazi inayoendeshwa na mwajiri.		12
m.	Government-run secretarial college Chuo cha mafunzo ya ukarani au biashara kinachoendeshwa na serikali.		13
n.	Private secretarial college chu cha mafunzo ya ukarani au biashara kinachoendeshwa na watu binafsi.		16
o.	Other *(specify)*		17
p	No reply		99

If a, b, c or d,—formal secondary school:
Which was the highest form achieved?
Ulimaliza darasa la ngapi?

(50)	N/A	0
		1
		2
		3
		4
		5
		6
no reply		9

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REPLY	CODE

For those who reached form 4:
What were your results in the National Form 4 Examination (formerly SC or '0' levels)?
Matokeo yako ya mtihani wa darasa la 12 yalikuwa-je?

				REPLY	CODE
		(53)		N/A	0
a.	Division 1				1
b.	Division 2				2
c.	Division 3				3
d.	Division 4				4
e.	Fail				5
f.	Did not sit				6
g.	No reply				9

What was your grade in the following subjects?
Ulipata nini kwenye masomo yafuatayo?

			REPLY	CODE
			N/A	0
a.	Maths Hesabu	(54)		
b.	English Kiingereza	(55)		
c.	Your best science subject *(specify)* Somo la sayansi ulilofanya vizuri kupita yote *(litaje)*	(56)		
d.	Your practical subject *(specify)* Somo lako la kazi za mikono *(litaje)*	(57)		

Which school did you attend? (the last school)
Ulisoma hule gani? (uliyosoma mwishoni)

	REPLY	CODE
(58)	N/A	000
	—	
(no reply)		999

Were you:

			REPLY	CODE
		(59)	N/A	0
a.	a border? ulikowa unakaa bwenini?			1
b.	a day pupil? ulikuwa unakaa nyumbani?			2
				9

For those who reached form 6: What were your results in the National Form 6 Examination (formerly HSC or 'A' level) (principal passes only)?
Matokeo yako ya mtihani wa darasa la 14 yalikuwa je?

			REPLY	CODE
		(60)	N/A	0
a.	no passes			8
b.	1 pass			1
c.	2 passes			2
d.	3 passes			3
e.	4 or more passes			4
f.	did not take			5
g.	no reply			9

What were your three best principal passes and the grade received in each?
Taja masomo kamili matatu uliyoshinda vizuri kuliko mengine?

				REPLY	CODE
1.	subject: ________	grade: ________	(61-62)		
2.	subject: ________	grade: ________	(63-64)		
3.	subject: ________	grade: ________	(65-66)		

Which school did you attend?
(the last school)
Ulisoma shule gani? (uliyosoma mwishoni)

		REPLY	CODE
	(67)	N/A	000
		—	
			999

Were you:

		REPLY	CODE
	(68)	N/A	0
a. a border? ulikowa unakaa bwenini?			1
b. a day pupil? ulikuwa unakaa nyumbani?			2
			9

For those who attended a teacher training college (College of National Education).
How long was the course? __________ years.
Mfunzo yalichukua muda gani?
For what teaching grade did the course qualify you?
Ulihitimu kuwa mwalimu wa ngazi gani?

		REPLY	CODE
	(69)	N/A	0
a. No qualification			1
b. grade A			2
c. grade B			3
d. grade C.			4
e. Other *(specify)*			5
f. no reply			9

For those who attended a university:
Did you obtain a degree?
Ulipata shahada

		REPLY	CODE
	(70)	N/A	0
yes			1
no			2
no reply			9

If yes: what was your highest degree?
Ni ipi shahada ya juu kabisa uliyopata?

		REPLY	CODE
	(71)	N/A	0
a. bachelors			1
b. masters			2
c. doctorate			3
d. no reply			9

If no: Did you obtain a diploma *(specify)*
Ulipata diploma? (eleza)

		REPLY	CODE
	(72)	N/A	0
yes			1
no			2
no reply			9

What subjects did you study?
Ulichukua masoma gani?

		REPLY	CODE
	(73-74),(75-76)	N/A	00
general arts			01
social sciences			02
history			03
languages			04
geography			05
engineering			06
sciences			07
law			08
medicine			10
agriculture			11
architecture			12
commerce			13
other *(specify)*			14
no reply			99

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		REPLY	CODE
Where did you attend university? Ulisoma chuo kikuu kipi?		N/A	0
	Dar		3
	Makerere		2
	Nairobi		1
	elsewhere *(specify)*		4
	No reply		9

4a. What was the highest level of education that your spouse received?
Mke/Mume wako amesoma mpaka daraja gani?

none hakwenda shule		0
primary shule ya msingi		1
secondary sekondari		2
other post-primary (eg. pre-service training) zaidi ya shule ya msingi (kama mafunzo ya kakazi)		3
post-secondary zaidi ya sekondari		4
unmarried nakuolewa/hakuoa		5
no reply		9

Employee number	(1-4)	
Card number	(5)	2

5. Have you attempted a craft trade test?
Umewahi kujaribu mtihani wa ufundi unaotolewa na serikali?

yes	(6)		1
no			2
no reply			9

If yes: What were your results? Matokeo yake yalikuwa-je?		(7-8)	N/A	00
Grade I	Pass			00
	Fail			01
	Did not sit			03
Grade II	Pass			04
	Fail			05
	Did not sit			06
Grade III	Pass			07
	Fail			08
	Did not sit			10
No reply				

What subject was the test in?
Mtihani ulikuwa katika somo lipi?

		REPLY	CODE
	(9), (10)	N/A	0
a. **engineering** **uhandisi**			1
b. **building** **ujenzi**			2
c. **woodwork** **useremala**			3
d. **electrical** **umeme (ufundi wa)**			4
e. **tailoring** **ushonaji**			5
f. **shoe making** **kutengeneza viatu**			6
g. other *(specify)* **mengine *(yataje)***			8
h. no reply			9

6. In what year did you complete your formal education or pre-service training?
Mwaka gani ulimaliza shule au elimu ya mafunzo ya Kazi?

		N/A	
19________	(11-12)		
no reply			99

7. At the time you left formal education did you want to continue?
Ulikuwa bado unataka kuendelea na masomo ulipoacha shule?

		N/A	
yes	(13)		1
no			2
no reply			9

If yes: why didn't you?
Kwanini hukuendelea?

	(14)	N/A	0
a. grades not high enough sikufanya vizuri ya kuteka kuhitimu			1
b. no school available locally ukosefu wa shule nilikoishi			2
c. could not afford school fees sikuwa na ada ya shule			3
d. had to work to support family ilinibidi kufanya kazi kwa ajili ya kusaidia familia			4
e. became pregnant kwa ajili ya kupata mimba			5
f. other *(specify)* sababu nyingine *(zitaje)*			6
g. no reply			9

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8. Do you want your sons to have more education than you had, if they have the opportunity?
Je, kama itawezekana, unataka watoto wako wa kiume wapate elimu zaidi kuliko uliyopata wewe?

		REPLY	CODE
yes	(15)		1
no			2
no reply			9

If yes: Why? (give the main reason)
Kwa nini?

		REPLY	CODE
	(16)	N/A	0
a. better job kazi nzuri zaidi			1
b. higher pay mshahara mkubwa zaidi			2
c. occupation hoped for requires it kufuatana na mahitaji ya kazi inayonuiwa			3
d. position in society kufuatana na mazingara ya maisha			4
e. service to the community kufuatana na mahitaji ya jumuia			5
f. cultural enrichment kuendeleza mila na utamaduni			6
g. no reply			9

9. If after leaving primary school your son could not continue to a government secondary school, what would you do?
Kama baada ya kumaliza shule ya msingi mtoto wako wa kiume hakupata nafasi katika sekondari ya serikali utafanya nini?

		REPLY	CODE
a. pay his fees for a private school nitampeleka shule ya 'private'	(17)		1
b. send him to a craft school nitampeleka kwenye shule ya kazi za mikono			2
c. send him out to work nitampeleka kufanya kazi			3
d. apprentice him (to acquire skills) nitampeleka mahali kujifunza kazi			4
e. get him to repeat primary leaving certificate nitamfanya arudie			5
f. other *(specify)* vingine *(eleza)*			6
g. no reply			9

9a. Do you want your daughters to have more education than you had if they have the opportunity?
Je, kama ikiwezekana, unataka watoto wako wa kike wapate elimu zaidi kuliko uliyopata wewe?

		REPLY	CODE
yes	(18)		1
no			2
no reply			9

		REPLY	CODE
If yes: Why? Kwa nini?	(19)	N/A	0
a. better job kazi nzuri zaidi			1
b. higher pay mshahara mkubwa zaidi			2
c. occupation hoped for requires it kufuatana na mahitaji ya kazi inayonuiwa			3
d. position in society			4
e. service to the community kufuatana no mahitaji ya jumuiya			5
f. cultural enrichment kuendeleza mila na utamaduni			6
g. no reply			9
9b. If after leaving primary school your daughter could not continue to a government secondary school, what would you do? Kama baada ya kumaliza shule ya msingi, mtoto wako wa kike hakupata nafasi katika sekondari ya serikali utafanya nini?			
a. pay her fees for a private school nitampeleka shule ya 'private'	(20)		1
b. send her to a craft school nitampeleka kwenye shule ya kazi za mikono			2
c. send her to work nitampeleka kufanya kazi			3
d. apprentice her nitampeleka mahali kujifunza kazi			4
e. get her to repeat primary leaving certificate nitamfanya arudie			5
f. keep her at home nitamweka nyumbani			6
g. other *(specify)* vingine *(eleza)*			7
h. no reply			9
10. *To be asked in English.* How many years did you study English?	(21-22)		
Can you speak English?			
Not at all	(23)		0
A little			1
Fluently			2
No reply			9
Can you read and write English			
Not at all	(24)		0
A little			1
Fluently			2
No reply			9

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IV. Earnings

1. Are you paid by
Unalipwa kwa:

	REPLY	CODE
the day siku	(25)	1
the week wiki		2
the month mwezi		3
no reply		9

2. How much did you receive, including housing allowances but excluding annual bonus, from the firm last period (after deductions)? (shillings)
Malipo kutoka kazini pamoja na marupurupu kwa ajili ya kodi ya nyumba na bila bakshishi ya mwaka yaliluwa kiasi gani mara ya mwisho (baada ya kukatwa kodi ya mapato na mengineyo)?

Basic wage
plus housing allowance
plus overtime payments
plus other *(specify)*
less employee NPF contributions
less tax deducted
gives

(26-31)

3. How many shillings of this was for overtime? (shillings)
Kati ya hayo malipo, kiasi gani kilitokana na 'overtime'?

(32-35)

4. Did you receive an annual bonus?
Ulipata bakshishi ya mwaka?

yes	(36)	1
no		2
no reply		9

If yes: how much? (shillings)
kiasi gani?

	(37-40) N/A	0000
no reply		9999

When do you receive it?
Huwa unaipata lini?

	(41-42) N/A	00
month		
reply		99

5. Is housing provided by the firm free or at reduced prices?
Je, kampuni inatoa nyumba za kuishi bure au kwa kodi ya chini zaidi kuliko mahali pengine?

yes	(43)	1
no		2
no reply		9

6. Is annual paid leave provided by the firm?
Je, unapata likizo ya mwaka (pamoja na malipo)?

yes	(44)	1
no		2
no reply		9

7. Are rations provided by the firm free or at reduced prices?
Je, kampuni inatoa chakula cha bure au kwa bei nafuu?

yes	(45)	1
no		2
no reply		9

REPLY	CODE

8. Is medical treatment provided by the firm free or at reduced prices?
Je, kampuni inatoa matibabu bure au kwa bei nafuu?

yes	(46)		1
no			2
no reply			9

9. Is transport to work provided by the firm free or at reduced prices?
Je, kampuni inatoa msaada wa usafiri kwenda na kutoka kazini bure au kwa bei nafuu?

yes	(47)		1
no			2
no reply			9

10. Does the employer contribute to the National Provident Fund for you?
Je, kampuni inakuchangia kwenye mpango wa National Provident Fund?

yes	(48)		1
no			2
no reply			9

11. Does the employer contribute to any other pension scheme for you?
Je, mwajiri wako anashiriki katika mpango mwingine wowote wa 'pension' kwa ajili yako?

yes	(49)		1
no			2
no reply			9

12. Will your employer lend you money if necessary?
Je, mwajiri wako atakukopesha fedha ukiwa na shida ya lazima?

yes	(50)		1
no			2
no reply			9

13. Do you have other sources of income from:
Je, una njia nyingine za mapato?

none	(51) (52)		0
hapana			
farm			1
shamba			
shop			2
duka			
kiosk			3
kibanda cha barabarani			
taxi			4
houses or rooms you rent out vya kupangisha			5
other *(specify)*			6
nyingine *(taja)*			
no reply			9

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If yes: Roughly how much (shillings) per month?
Makisio ya haya mapato ni kiasi gani kwa mwezi?

		REPLY	CODE
		N/A	0000
per month / kwa mwezi	(53-56)		
or per day / au kwa siku			
or per year / au kwa mwaka			
no reply			9999

V. Employment Experience in the Firm

		REPLY	CODE

1. In what year did you join the firm? 19________
Ni mwaka gani ulianza kazi hapa?

	(57-58)		

2. Are you now a regular or casual worker?
Wewe ni mfanya kazi wa kudumu au kibarua?

Regular	(59)		1
Casual			2
No reply			9

3. *If regular:* Did you start in this firm as a casual worker?
Je, ulianza kazi hapa kama kibarua?

	(60)	N/A	0
Yes			1
No			2
No reply			9

4. *If no:* Would you have got your job if you had received less education?
Ungeweza kuipata hii kazi kama ungekuwa na kisomo cha chini ya ulichokuwa nacho?

	(61)	N/A	0
Yes			1
No			2
Don't know			3
No reply			9

If yes to question 3: When you became a regular employee, would you have got your job if you had received less education?
Ulipofanywa mfanya kazi wa kudumu ungeipata hiyo kazi kama ungekuwa na kisomo chini ya ulichokuwa nacho?

	(62)	N/A	0
Yes			1
No			2
Don't know			3
No reply			9

5. If casual: Would you have got your job if you had received less education?

	(63)	N/A	0
No			1
No			2
Don't know			3
No reply			9

6 How did you get your job with this employer?
Ulitumia njia gani kupata kazi hapo unapofanya sasa?

		REPLY	CODE
a. At the gate Kuulizia kwenye 'gate'	(64-65)(66-67)		01
b. By letter, in response to an advertisement Barua baada ya kuona tangazo			02
b. By letter, unsolicited Barua bila msaada			03
d. Through a friend or relative Kupitia kwa rafiki au jamaa			04
e. Through the Government Employment Exchange Kupitia Government Employment Exchange			05
f. Allocation by Government Nilipangiwa na serikali			06
g. Through a private employment agency Kupitia kwa kampuni inayoshughulika na uajiri ya watu binafsi			07
h. National Service Scheme Mpango wa kujenga Taifa			08
i. Other *(specify)* Nyingine *(eleza)*			10
j. No reply			99

7. Fill in details of current occupation on the occupation form.

8. Is the skill level in your current job higher, lower, or about the same as in the job you held when you first joined this employer?
Ujuzi wa kazi yako sasa ni wa juu zaidi, chini zaidi au ni sawa na wa kazi uliyoanzia kwa huyu mwajiriwako?

	(68)	N/A	0
Higher			1
Lower			2
The same			3
Don't know			4
No reply			9

9 Has the employer given you a training course?
Mwagiri amewahi kukupa mafunzo ya kikazi?

Yes	(69)		1
No			2
No reply			9

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			REPLY	CODE
If yes: how many courses? mara ngapi?		(70)	N/A	0
	No reply			9
(If more than one, the questions relate to the main one.)				
Was it: Ilikuwa:		(71)	N/A	0
	pre-servoice kabla ya kuanza kazi			1
	in-service kama mfanya kazi			2
	no reply			9
Was it: Ilikuwa:		(72)	N/A	0
	in the firm kazini			1
	in some outside institution mahali pengine			2
	no reply			9
How long was this course? (code in months) Mafunzo yalichukua muda gani?		(73-74)	N/A	00
	weeks			
	or months			
	no reply			99
Was the course: Mafunzo yal[illegible]a:		(75)	N/A	0
	full-time kila siku			1
	part-time siku moja moja			2
	no reply			9
Did you receive full pay while attending this course; Ulikuwa unalipwa mshahara wako wote ulipokuwa mafunzoni?		(76)	N/A	0
	yes			1
	no			2
	no reply			9
Did you receive higher pay after completing the course? Uliongezwa mshahara baada ya kumaliza mafunzo?		(77)	N/A	0
	yes			1
	no			2
	no reply			9
Employee number		(1-4)		
Card number		(5)		3

10. Do you think your education qualifies you for a job at a higher level than your present job?
Je, kufuatana na kisoma chako unafikiri ungeweza kufanya kazi yenye madaraka zaidi kuliko uliyo nayo sasa?

		REPLY	CODE
yes	(6)		1
no			2
don't know			3
no reply			9

If yes: Why are you in your current job?
Kwa nini unafanya hii kazi ya sasa?

			REPLY	CODE
		(7)	N/A	0
a.	to gain experience, or skill kupata mazoezi au uiuzi			1
b.	too junior for higher job at the moment umri wangu au muda niliokaa hapa ni mdogo kuliko inavyotakiwa			2
c.	no higher level jobs available ukosefu wa kazi yenye madaraka zaidi			3
d.	other *(specify)* kwa ajili ya sababu nyingine *(zitaje)*.			4
e.	No reply			9

11. Do you think that you could perform your present job as well if you had not received your final stage of education?
Je, unafikiri ungeweza kuifanya kazi yako ya sasa sawa na kama vile usingekuwa umefikia daraja la kisomo ulicho nacho?

		REPLY	CODE
	(8)	N/A	0
yes			1
no			2
don't know			3
no reply			9

12. Do you think you could do your present job better if you had completed the next stage of education?
Je, unafikiri ungeweza kuifanya kazi yako ya sasa vizuri zaidi kama ungeendelea na shule mpaka daraja la juu zaidi kuliko ulilofikia?

		REPLY	CODE
yes	(9)		1
no			2
don't know			3
no reply			9

13. Are you a trade union member?
Umejiunga na chama cha wafanya kazi?

		REPLY	CODE
no	(10-11)		00
yes			
no reply			99

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14 How much were you paid (after deductions) when you first joined this firm? (shillings per month)
Ulikuwa unalipwa kiasi gani (baada ya kukatwa kodi na mengineyo) ulipoanza kazi kwenye hii kampuni?

		REPLY	CODE
	(12-16)		
don't know			
no reply			99999

15. Are you actively looking for a better job in some other firm?
Je, unajitahidi kutafuta kazi nzuri zaidi mahali pengine?

		REPLY	CODE
yes	(17)		1
no			2
no reply			9

VI. Previous Employment Experience

If no formal education proceed to Question 3.

1. Did you interrupt your formal education for a year or more?
Je, ulipokuwa unasoma shule uliwahi kuacha masomo kwa mwaka au zaidi halafu ukarudi tena kuendelea?

		REPLY	CODE
		N/A	0
yes	(18)		1
no			2
no reply			9

If yes: During that time how long did you spend doing the following?
Wakati huo, ulijishughulisha kwa muda gani na yafuatayo?

		MONTHS	YEARS	
a. worked on parent's shamba kusaidia kwenye shamba la wazazi	(19)			
b. worked on own shamba kufanya kazi kwenye shamba lako	(20)			
c. non-agricultural employment (eg. street vending, small businesses, etc.); kazi isiyokuwa ya kilimo (kwa mfano ku kutembeza na kuuza vitu barabarani)	(21)			
d. unemployed and looking for wage employment kushughulika kutafuta kazi ya kulipwa	(22)			
e. unemployed and not looking for work kukaa tu bila kufanya kazi wala kutafuta	(23)			
f. employed in a wage job kufanya kazi ya kulipwa	(24)			
g. National Service Kujenga Taifa	(25)			

2. How long was it after you left full time education or training before you got wage employment? (code in months)
Baada ya kumaliza shule, ilikuchukua muda gani kabla ya kuajiriwa?

		REPLY	CODE
immediately	(26-28)		000
months			
or years			—
don't know			
no reply *(include people with no formal education)*			999

If not immediately: How long did you spend doing the following?
Ulijishughulisha kwa muda gani na yafuatayo?
(code in months)

			N/A	000
		MONTHS	YEARS	
a. worked on parent's shamba kusaidia kwenye shamba la wazazi	(29-31)			
b. worked on own shamba kufanya kazi kwenye shamba lako	(32-34)			
c. non-agricultural self-employment eg. street vending, small businesses) kazi ya binafsi isiyokuwa ya kilimo (kwa mfano kutembeza na kuuza vitu barabarani)	(35-37)			
d. unemployed and looking for wage employment bila kazi hali unashughulika kutafuta kazi ya kulipwa	(38-40)			
e. unemployed and not looking for wage employment kukaa tu bila kufanya au kutafuta kazi	(41-43)			
f. Other *(specify)*	(44)			

3. Were you in wage employment at any time before coming to this employer (exclude employment during school holidays or university vacation)?
Umewahi kuajiriwa mahali pengine kabla ya hapa ulipo sasa (kuacha wakati wa likizo ulipokuwa unasoma)?

yes	(46)		1
no			2
no reply			9

If no: go to Section VII.

4. In what year did you get your first wage job? 19________
Uliajiriwa kwa mara ya kwanza mwaka gani?

	(47-48)	N/A	00
no reply			99

5. Have you been continuously in wage employment since then (without a break of more than a month)?
Baada ya hapo, umewahi kukaa bila kuajiriwa kwa zaidi ya mwezi?

	(49)	N/A	0
yes			1
no			2
no reply			9

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REPLY	CODE

6. *If no:* How many times have you been out of wage employment?
Umekaa bila kuajiriwa mara ngapi?

	N/A	0
number of times		
no reply		9

How long in total were you out of wage employment?
Kwa ujumla ni muda gani umekaa bila kuajiriwa?

	N/A	
(months)		
no reply		99

What did you do? (main activity)
Ulifanya nini? (shughuli muhimu)

	First Time MONTHS	Second Time MONTHS	Most Recent Time MONTHS
1 worked on parent's shamba kusaidia kwenye shamba la wazazi			
2 worked on own shamba kufanya kazi katika shamba langu			
3 non-agricultural self-employment (eg. street vending) Kazi binafsi isiyokuwa ya kilimo (kwa mfano kutembeza na kunza vitu barabarani)			
4 unemployed and looking for wage employment Kushughulika kutafuta kazi ya kuajiriwa			
5 Unemployed and not looking for work Kukaa bila kufanya au kutafuta kazi			
6 returned to education Kurudi shuleni kuendelea na masomo			

7. How many *previous* employers have you had?
Umewahi kuwa na waajiri wangapi kabla ya huyu wa sasa?

	N/A	0
1		1
2		2
3		3
4		4
5		5
6		6
7		7
8 or more		8
no reply		9

If none: go to Section VII.

8. *(Exclude wage employment during school or college vacations.)*
What was the name of your employer in? your last job ________________
kazi yako ya mwisho
Mwajiri wako alikuwa ni nani? your first job ________________
kazi yako ya mwanzo

	YOUR LAST JOB			YOUR FIRST JOB		
	COL	REPLY	CODE	COL	REPLY	CODE
How many people worked for the establishment?						
Kulikuwa na wafanya kazi wangapi kwenye hiyo karakana?	(60)	N/A	0	(61)	N/A	0
a. less than 50 employees			1			1
b. 50-499 employees			2			2
c. 500-employees			3			3
d. don't know			4			4
e. no reply			9			9
What goods or service did the enterprise produce?						
Kampuni ilikuwa inatengeneza vitu au kutoa huduma za aina gani?	(62-63)	N/A	00	(64-65)	N/A	00
a. agriculture and forestry			01			01
b. mining and quarrying			02			02
c. manufacturing			03			03
d. electricity and water			04			04
e. construction			05			05
f. wholesale and retail trade, restaurants and hotels			06			06
g. transport and communication			07			07
h. finance, insurance, real estate and business services			08			08
i. community, social and personal services			10			10
j. don't know			11			11
k. no reply			99			99
Was the employer?						
Je, mwajiri alikuwa ni	(66)	N/A	0	(67)	N/A	0
a. the government serikali			1			1
b. a parastatal masharika ya uma			2			2
c. in the private sector kampuni ya watu binafsi			3			3
d. a local authority tawala za serikali ya miji au mitaa			4			4
e. no reply			9			9

Fill in details of the occupation on the occupation form

	COL	REPLY	CODE	COL	REPLY	CODE
How long were you in this job? Ulifanya hii kazi kwa muda gani?	(72-73)	N/A	00	(74-75)	N/A	00
months			—			—
years						
(code in years) no reply			99			99

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Employee number	(1-4)		
Card number	(5)	4	

		YOUR LAST JOB			YOUR FIRST JOB		
		COL	REPLY	CODE	COL	REPLY	CODE
What was your wage at the end of this job? Mshahara wako ulikuwa kiasi gani ulipoacha hii kazi? (shillings per month)		(6-10)	N/A	00000	(11-15)	N/A	00000
	no reply			99999			99999
What was your wage at the beginning of this job? Mshahara wako ulikuwa kiasi gani ulipoanza hii kazi? (shillings per month)		(16-20)	N/A	00000	(21-25)	N/A	00000
	no reply			99999			99999
Why did you leave? Kwa nini uliondoka?		(26)	N/A	0	(27)	N/A	0
	lost job (sacked or made redundant)			1			1
	chose to leave (to look for or take up better job)			2			2
	Other *(specify)*			3			3
	no reply			9			9
Did you receive higher pay at the start of your next job? Kwenye kazi iliyofuata ulianzia mshahara mkubwa zaidi?		(28)	N/A	0	(29)	N/A	0
	yes			1			1
	no			2			2
	no reply			9			9

VII. Rural-Urban Links

			REPLY	CODE
1.	In which district were you born? ______________________________ Wewe ni mazaliwa wa wilaya gani?	(30-31)	N/A	00
	no reply			99
2.	In what district was your father born? ______________________________ Baba yako alizaliwa kwenye wilaya ipi?	(32-33)	N/A	00
	no reply			99

3. How old were you when you first came to live in Dar?
U'likuwa na umri gani ulipoanza kuishi Dar? (34)

a. born in Dar		NON-MIGRANT	1
b. age in years if 1 to 13		NON-MIGRANT	1
c. age in years if 14 or over		MIGRANT	2
d. don't know		—	
e. reply		—	9

	REPLY	CODE

If a non-migrant, proceed to question 6

4. *If a migrant:* in what year did you come to live in Dar?
Ulianza kuishi Dar mwaka gani?

(35-36)	N/A	00
		99

5. *If a migrant:* did you complete your formal education before or after you came to Dar?
Ulianza kuishi Dar kabla au baada ya kumaliza shule?

before
after
no reply

(37)	N/A	0
		1
		2
		9

If before: how long did it take to find an independent source of income when you arrived in Dar?
Baada ya kufika Dar ilikuchukua muda gani mpaka ulipoweza kujipatia mahitaji yako mwenyewe?

immediately
months
no reply

(38-39)	N/A	00
		01
		99

How did you earn this?
Mapato yako yalitoka wapi?

a. same employer I have now
mwajiri wa sasa
b. same kind of job with another employer
kazi kama hii kwa mwajiri mwingine
c. other wage job for a fundi
kazi ya kulipwa ya aina nyingine ya ufundi
d. other wage job for a firm
kazi ya kulipwa ya aina nyingine kwenye kampuni
c. self-employment
kazi ya binafsi
f. no reply

(40)	N/A	0
		1
		2
		3
		4
		5
		9

For all respondents:

6. Do you have a shamba (or access to an ujamaa shamba)?
Je, una shamba?

yes, private
ndiyo la binafsi
yes, private and communal
ndiyo, la binafsi na biashara
yes, communal
ndiyo, la uja maa
no
no reply

(41)		1
		2
		3
		4
		9

If no: proceed to question 7.
If yes: How did you acquire it?
Ulipata je?

a. inheritance
uridhi
b. allocation after land reform
kupangiwa ya mpango mpya agawaji wa andhi

	N/A	0
(42)		1
		2

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		REPLY	CODE
c. purchase kununua			3
d. land borrowing andhi ya kukopa			4
e. marriage ndoa			5
f. other *(specify)* vingine *(eleza)*			6
g. no reply			9

If purchase: Did you take out a loan to help in the purchase?
Ulichukua mkopo ili kuweza kununua hilo shaba?

	(43)	N/A	0
yes			1
no			2
no reply			9

How large is your shamba?
Shamba lako ni kubwa kiasi gani?

	(44-46)	N/A	000
hectares			—
or acres			
no reply			999

What are the two main cash crops on your shamba?
Taja mazao makuu mawili yanyokuletea kipato una fedha?
Indicate crops and also quantities specifying units of
measurement (e.g. coffee and tea; number of trees)

	(47-49)		
	(50-52)		

How many livestock do you have on the shamba?
Una wanyama (mifugo) wangapi shambani mwako?

	(53-55)		

How often do you visit your shamba? (per year)
Je, huwa unatembelea shamba lako mara ngapi (kwa mwaka)?

	(56-57)	N/A	00
no reply			99

How much did you spend last year on purchased inputs such as
seed and fertilizer for your shamba? (exclude hired labor)
Mwaka jana ulitumia fedha kiasi gani kununulia vifaa vya
shamba, kama vile mbolea, mbegu na kadhalika?

	(58-61)	N/A	0000
shillings			
no reply			9999

How many other workers help your family on the shamba?
Wafanya kazi wangapi wengine wanaisaida familia yako shambani?

	(62)	N/A	0
number			
no reply			9

Who decides what crops to grow on your shamba?
Ni nani anayetoa unamuzi kuhusu mazao yatakayolimwa shambani kwako?

	(63)	N/A	0
a. self mwenyewe			1
b. spouse mke/mume			2
c. village manager mkurugenzi wa kijiji			3
d. village committee kamati ya kijiji			4
e. other *(specify)* mtu mwingine *(mtaje)*			5
f. no reply			9

7. Is it your plan at some time to go and live in a rual area?
Je, una mpango wa kwenda kuishi mashambani baadaye?

		REPLY	CODE
yes	(68)		1
no			2
no reply			9

If yes: when?
lini?

	(69)	N/A	0
a. When my employer retires me Nitakapostahafishwa			1
b. When I have reached a particular age *(specify _______ years)* Nitakapofikia umri fulani *(taja miaka _______)*			2
c. When I have saved enough money Baada ya kuwa na akiba ya kutosha			3
d. When I have finished paying for my shamba Nikimaliza kulipa mkopa wa shamba			4
e. When I inherit a shamba Nitakaporidhi shamba			5
f. When I have finished building a house Nikimaliza kujenga nyumba			6
g. When my children no longer need support Baada ya watoto kuacha kunitegemea			7
h. Other *(specify)* Wakati mwingine *(eleza)*			8
j. No reply			9

8. How many wives do you have (or do you have a husband)?:
Je, una wake wangapi (au una mume)?:

a. In Dar? Hapa Dar	(70)		
b. On your shamba Shambani kwako	(71)		
c. Elsewhere Mahali pengine	(72)		

9. How many children do you have?
Je, una watoto wangapi?

a. In Dar Hapa Dar	(73-74)		
b. On your shamba Shambani kwako	(75-76)		
c. Elsewhere Mahali pengine	(77-78)		

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10. To what tribe do you belong?
Wewe ni kabila gani?

	REPLY	CODE
	N/A	0
a. Sukuma		01
b. Makonde		02
c. Chagga		03
d. Haya		04
e. Nyamwezi		05
f. Ha		06
g. Hehe		07
h. Gogo		08
i. Nyakyusa		09
j. Sambao		10
k. Luguru		11
l. Bena		12
m. Turu		13
n. Other *(specify)*		14
o. No reply		99

Employee number	
Card number	5

11. Do you use some of your earnings to help support relatives outside Dar?
Je, unatumia sehemu ya mapato yako kwa ajili ya kuwasaidia jamaa zako walio nje ya Dar?

yes		1
no		2
no reply		9

If yes: What forms does this support take?
Hua msaada ni wa aina gani?

		N/A	0
a	remittances of money (including school fees) Kuwapelekea fedha (pampoja na ada ya shule)		1
b	purchase of goods Kuwanunulia vitu		2
c	other *(specify)* ______ Nyingine *(eleza)*		3
d	no reply		9

		REPLY	CODE
If remittances: how many times a year? • Unapeleka fedha mara ngapi kwa mwaka?	(8-9)	N/A	00
no reply			99
What was the value of your last remittance (shillings)? Fedha ulizopeleka mara ya mwisho zilikwa kiasi gani?	(10-13)	N/A	0000
no reply			9999
About how much does the support you give to relatives cost you a year? (shillings) Jumla ya fedha unazotumia kwa ajili ya kuwasaidia jamaa zako ni kiasi gani kwa mwaka?	(14-18)	N/A	00000
no reply			99999
What is your help used for? Msaada wako unatumi wa kwa manufaa gani? *(code as follows:* yes = 1 no = 2 no reply = 9)		N/A	0
a. education elimu	(19)		
b. house construction or improvement kujenga au kuimarisha nyumba	(20)		
c. farm improvement kuendeleza shamba	(21)		
d. consumer goods kununulia bidhaa	(22)		
e. food chakula	(23)		
f. general purposes matumizi ya kawaida	(24)		
g. other *(specify)* mengine (eleza)	(25)		

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VIII. Education of Children

			REPLY	CODE
1.	How many children do you have below primary school age? Una watoto wangapi ambao hawajafikia umri wa kwanza shule ya msingi?	[illegible]		
	How many children do you have old enough to have gone to school but who never attended? Una watoto wangapi ambao wamefikia umri wa kwenda shule lakini hawajawahi kwenda shule?	[illegible]		
3.	How many children do you have in formal education at present? Kwa sasa, ni watoto wangapi wanaosoma shule?	[illegible]		
4.	How many children do you have who have completed their formal education? Una watoto wangapi ambao wameshamaliza shule?	[illegible]		

5. Consider your three eldest children aged 6 or over (if any).
Fikiria watoto wako watatu wakubwa ambao wana umri wa miaka 6 na kuendelea (kama unawo)

	CHILD 1			CHILD 2			CHILD 3		
	COL	REPLY	CODE	COL	REPLY	CODE	COL	REPLY	CODE
		N/A	0		N/A	0		N/A	0
Sex: male	(35)		1	(49)		1	(63)		1
female			2			2			2
Age: (years)	(36-37)			(50-51)			(64-65)		
don't know or not applicable			99			99			99
Highest level of education Elimu ya juu kabisa waliyofikia									
no education	(38-39)		00	(52-53)		00	(66-67)		00
Standard 1			01			01			01
Standard 2			02			02			02
Standard 3			03			03			03
Standard 4			04			04			04
Standard 5			05			05			05
Standard 6			06			06			06
Standard 7			07			07			07
Standard 8			08			08			08
Form 1			10			10			10
Form 2			11			11			11
Form 3			12			12			12
Form 4			13			13			13
Form 5			14			14			14
Form 6			15			15			15
University			16			16			16
Other post-secondary *(specify)*			17			17			17
Other *(specify)*			18			18			18
no reply or not applicable			99			99			99

	CHILD 1			CHILD 2			CHILD 3		
	COL	REPLY	CODE	COL	REPLY	CODE	COL	REPLY	CODE
Was/Is the last education institution		N/A	0		N/A	0		N/A	0
a. Government	(40)		1	(54)		1	(68)		1
b. Private			2			2			2
Mara ya mwisha alikuwa/yupo kwenye shule ya, au chuo cha: a. Serikali b. 'Private'									
Is the education continuing? Bado anaendelea na masomo?	N/A		0		N/A	0		N/A	0
yes	(41)		1	(55)		1	(69)		1
no			2			2			2
no reply			9			9			9
If no: when was it completed? Alimaliza kusoma lini? 19 ______	(42-43)	N/A	00	(56-57)	N/A	00	(70-71)	N/A	00
don't know			99			99			99
If yes: How much did the education cost you last year (shillings) Mwaka jana ulitumia fedha kiasi gani kwa ajili ya ada na mahitaji ya shule?	(44-47)			(58-61)			(72-75)		
No reply or not applicable			9999			9999			9999
Is/Was the last education: Mara ya mwisho alisoma/anasoma:									
a. In Dar Dar	(48)		1	(62)		1	(76)		
b. in your rural area nyumbani kijijini			2			2			2
c. elsewhere mahali pengine			3			3			3
d. no reply			9			9			9

6. How much did the education of *all* your children cost you last year? (shillings)
Mwaka jana ulitumia fedha kiasi gani kwa ajili ya elimu ya watoto wako wote?

	COL	REPLY	CODE
	(77-80)	N/A	0000
no reply			9999

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Employee Questionnaire

		REPLY	CODE
Employee Number	(1-4)		
Card number	(5)		6

IX. Miscellaneous

1. Occupation

Current job	(6-11)		
Last job	(12-17)		
First job	(18-23)		

2. Wage information obtained from employer (shillings per month)

	Basic wage	(24-29)	
	Housing allowance	(30-33)	
	Overtime payment	(34-37)	
less	Employee contribution to NPF	(38-41)	
	Tax deducted	(42-45)	

For those who reached Form 4 or above:

3. How did you obtain your first wage job (exclude National Service or wage employment during school or college vacations)?
Ulipataje kazi yako ya kwanza (kuondoa kazi ya kujenga taifa na pia kazi za likizoni wakati ukiwa masononi

		N/A	*0*
1. Government allocation Kupangiwa na serikali	(46)		*1*
2. Application Maombi			*2*
3. Other *(specify)* ______________________ Nyingine *(taja)*			3
4. No reply Hakuna jibu			9

If through Government allocation:
On your list of preferences, was this job:
Kwenye arodha ya mapendekezo, kazi hii ilikuwa ya

		N/A	0
1. first kwanza	(47)		1
2. second pili			2
3. third tatu			3
4. lower chini zaidi			4

		REPLY	CODE
5. not your choice haikuwa kwenye chaguo lako			5
6. no reply hakuna jibu			9
4. Were you bonded by Government? Ulikuwa umelazimika kwa nkataba kuitumikia serikali?			
Yes Ndiyo	(48)		1
no Hapana			2
no reply Hakuna jibu			9
If yes: Kama ndiyo: Did you serve out your bond? Ulitmiza nikataba wako?		N/A	0
Yes Ndiyo	(49)		1
No Hapana			2
No reply Hakura jibu			9
If did not serve out bond: *Kama hukutimiza nikabata* Is this because: Inamaeuisha	(50)	N/A	0
1. you are still serving bado unaendelea			1
2. transferred by government ulihamishwa na serikali			2
3. managed to move to another job uliweza kuhahua kwenye kazi nyingine			3
4. no reply Hakuna jibu			9

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APPENDIX C

The Tests of Reasoning Ability and Cognitive Skill

FOR MOST DEVELOPING COUNTRIES the only information on the education of individuals that is available from labor force surveys concerns the number of years spent in school or the level of education attained. But only in a pure credentialist model of education is the simple level of education the relevant variable. Other models focus on the predetermined ability that is correlated with schooling or on the skills acquired in school. For the human capital model some measure of the output from the educational system is required.

This study is unusual in that it has data on the output of the educational system in the form of measures of literacy and numeracy and of predetermined reasoning ability, which may be a correlate of education. Three tests were administered to generate these data: tests of literacy and numeracy, based on the Kenyan and Tanzanian school curricula, and Raven's Coloured Progressive Matrices, which tests reasoning independent of acquired knowledge.

It was hoped that these tests of reasoning ability and cognitive skill would reveal something about the causal role of secondary schooling. The tests would permit the estimation not only of earnings functions containing these variables but also of educational attainment and production functions. By these means the influence of secondary schooling on earnings could be decomposed into the ability, screening, credentialist, and human capital effects.

Test Design

Raven's Coloured Progressive Matrices (Raven 1956) consists of three sets of twelve problems each. Each problem is a block of pattern with one piece missing, rather like a piece of wrapping paper with a hole cut out of it. Below the problem are six possible missing pieces, all of which match the size and shape of the "hole" but only one of which has the correct pattern. This test was designed in 1947 and was later revised. It

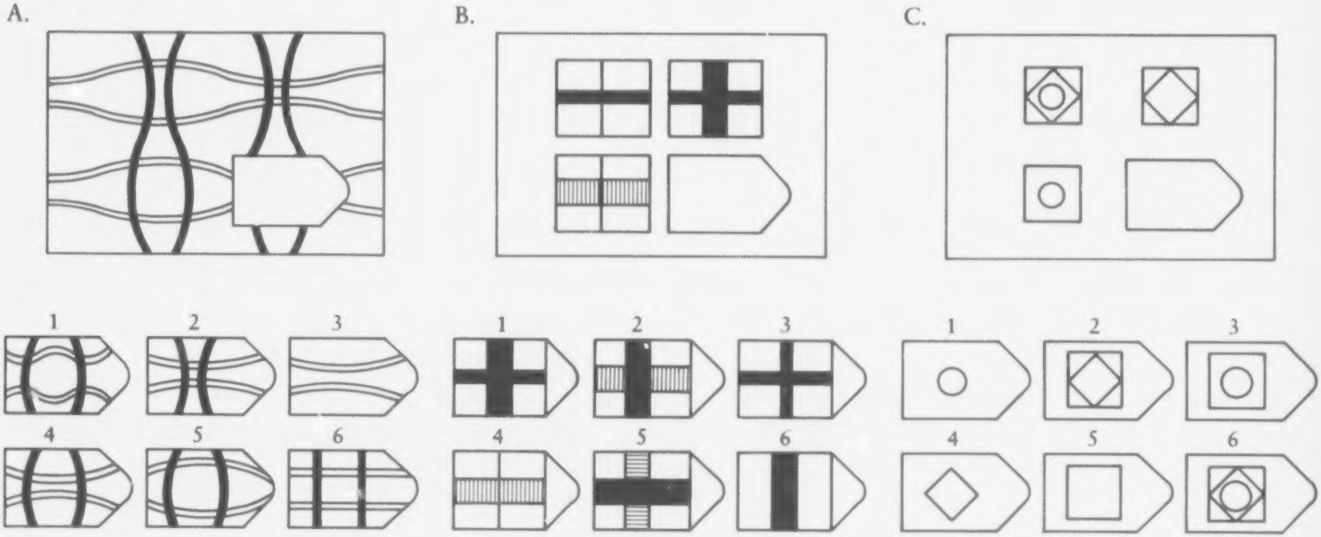

Figure C-1. *Sample Problems from Raven's Coloured Progressive Matrices*

A.
B.
C.
1
2
3
4
5
6
1
2
3
4
5
6
1
2
3
4
5
6

has been widely used in developing countries (see, for example, Klingelhofer 1967, Sinha 1968, and Wober 1969). Raven (1956) observes of the tests,

> They can be used satisfactorily with people who, for any reason, cannot understand or speak the English language . . . The scale as a whole can be described as a test of observation and clear thinking . . . the order in which the problems are presented provides the standard training in the method of working.

The test assesses a person's capacity for intellectual activity. It is untimed, since the speed of intellectual work has been found to improve with practice and a time limit would probably give more educated people an advantage. Because the test requires little or no explanation as to what to do, performance does not depend at all on language competence. Figure C-1 reproduces three of the thirty-six problems that make up the complete test, in order of difficulty; the patterns actually used are brightly colored.

The literacy and numeracy tests (figure C-2) were specially designed for this study by the Educational Testing Service, Princeton, N.J. During the first field trip the team collected teaching and testing materials from schools in Nairobi and Dar es Salaam so that the tests could be based on the sort of material included in the primary- and secondary-leaving examinations. Care was taken to guard against cultural bias. For example, comprehension passages that dealt with scenes or objects likely to be unfamiliar to East Africans were avoided. Respondents could choose whether to take the tests in English or in Kiswahili so that proficiency in the English language would not affect test performance.

Table C-1. *Reasoning and Cognitive Skill Tests: Subsample of Primary and Secondary Completers*

	Kenya		*Tanzania*	
Item	*Full sample*	*Test subsample*	*Full sample*	*Test subsample*
Mean wage (shillings per month)	1,217	1,173	909	886
Mean years of work experience	9.0	9.3	7.6	7.6
Occupational distribution (percent)				
Supervisory	6.8	5.0	9.7	9.7
Clerical	35.3	31.6	34.9	44.6
Skilled manual	22.1	30.9	19.6	15.1
Semiskilled manual	20.1	16.3	23.4	21.0
Unskilled manual	15.6	16.3	12.4	9.7
N	927	219	882	190

Figure C-2. *Selected Questions, in English and Kiswahili, from the Cognitive Skill Tests*

A. Numeracy

1. 105 − 16 = ?

   (a) 89 (b) 91 (c) 99 (d) 111

2. There are 4 rows of chairs and 12 chairs in each row. What is the total number of chairs?

   Kuna mistari 4 ya viti na kuna viti 12 katika kila mstari. Kuna jumla ya viti vingapi?

   (a) 12 + 4 (b) 12 − 4 (c) 12 x 4 (d) 12 ÷ 4

3. Which of the following numbers is the *largest*?

   Kati ya tarakimu zifuatazo, ni ipi kubwa kuliko zote?

   (a) 0.1 (b) 0.01 (c) 0.111 (d) 0.1101

4. 1% of 400 is:

   1% ya 400 ni:

   (a) 1 (b) 4 (c) 40 (d) 400

5. The height of a man is closest to 2 ———

   Urefu wa mwanamme unakaribia ——— 2

   (a) millimetres (b) metres (c) kilometres (d) centimetres

6. How many square inches are there in a square foot?

   Katika futi ya mraba moja kuna inchi za mraba ngapi?

   (a) 12 (b) 36 (c) 48 (d) 144

7. Two cities are 12 kilometres apart. Each day, a bus makes 3 round trips between these cities. How many kilometres does the bus travel each day?

   Kati ya miji miwili kuna umbali wa kilomita 12. Basi huwa linafanya safari 3 za kwenda na kurudi kila siku. Kwa siku?

   (a) 72 (b) 36 (c) 15 (d) 4

8. A meal costs 15/00. If a 10% service charge is to be added to the bill, what should the total charge be?

   Bei ya mlo mmoja ni sh. 15/00. Kama kuna nyongeza ya 10% kwa ajili ya huduma, bili itakuwa kiasi gani kwa ujumla?

   (a) 15/10 (b) 16/00 (c) 16/50 (d) 25/00

9. An island has an area of about 300 square miles. The government reports that the western 1/3 of the island is not suitable for cultivation. How many square miles of this island are suitable for cultivation?

   Kisiwa kina enso la maili za mraba 300. Serikali imetoa repoti kwamba 1/3 ya upande wa magharibi wa hicho kisiwa hanfai kwa kulimo. Je, maili za mraba ngapi zinazofaa kwa kilimo?

   (a) 50 (b) 100 (c) 150 (d) 200

10. In an office building, each office has about 22 square metres of floor space. In this building, a square office would measure about how many metres on each side?

    Katika jengo la maofisi, kila ofisi ina sakafu ya enso la mita za mraba 22. Katika hilo jengo kila ofisi ya mraba itakuwa na urefu wa mita ngapi kila upande?

    (a) 4.7 (b) 5.5 (c) 11 (d) 484

11. One number is 3 more than twice another. If x represents the smaller number, which of the following represents the larger number?

    Nambari moja ni mara 3 zaidi ya mara mbili ya nambari nyingine. Kama x ndiyo nambari ndogo, ni ipi kati ya zifuatazo ni sawa na nambari iliyo kubwa?

    (a) $2x + 3$ (b) $5x$ (c) $3(2x)$ d\(d) $2x - 3$

    If $a = -3$ and $b = 3$, then $2a + b^2 = ?$

    Kama $a = -3$ na $b = 3$, basi $2a + b^2 = ?$

    (a) 0 (b) 3 (c) 9 (d) 12

    If $2x - 3 = 17$, then $x = ?$

    Kama $2x - 3 = 17$, basi $x = ?$

    (a) 7 (b) 10 (c) 14 (d) 20

12. Which *cannot* be the intersection of 3 planes?

    (a) 1 point (b) 1 line (c) 3 concurrent lines (d) 3 parallel lines

    Ni ipi haiwezi kuwa mkutano wa nyuso tatu?

    (a) Nukta 1 (b) Mstari 1 (c) Mistari 3 iliyofuatana pamoja
    (d) Mistari 3 sambamba

B. Literacy

Directions: For questions 1–6, read the passages below. Each passage is followed by questions. Choose the correct answer to each question and mark the letter of that answer on your answer sheet.

Maelezo: Kwa maswali 1–6 soma fungu la maneno yafuatayo. Kila fungu la maneno limefuatwa na maswali. Chagua jibu linalofaa kwa kila swali halafu weka alama kwenye herufi inayofuatana na hilo jibu.

You could smell the fish market long before you could see it. As you came closer you could hear merchants calling out about fresh catches or housewives arguing about prices. Soon you could see the market itself, brightly lit and colorful. You could see fishing boats coming in, their decks covered with silver-grey fish.

1. What kind of a market is described above?
   - (a) A vegetable market
   - (b) A meat market
   - (c) A fish market
   - (d) A fruit market
2. What could you see coming in?
   - (a) Tug boats
   - (b) Rowboats
   - (c) Fishing boats
   - (d) Sailboats
3. What covered the decks of the boats?
   - (a) Rope
   - (b) People
   - (c) Boxes
   - (d) Fish

Unaweza kupata harufu ya soko la samaki kabla hata hujalifikia. Ukianza kukaribia sokoni, unaweza kuwasikia wauza ji wakiitia samaki ambao hawajakaa kwa muda tangu kuvuliwa au kina mama wakibishana juu ya bei. Punde unaliona soko lenyewe, na lina mwangaza mkubwa na rangi nyingi. Unaweza kuona mashua za kuvulia samaki zikiingia na ukumbi wake umejaa samaki wa rangi ya fedha.

1. Soko lililoelezewa hapo juu ni la namna gani?
   - (a) Soko la mboga
   - (b) Soko la nyama
   - (c) Soko la samaki
   - (d) Soko la matunda
2. Uliweza kuona kitu gani kikiwasili:
   - (a) Meli ndogo
   - (b) Mitumbwi
   - (c) Mashua za kuvulia samaki
   - (d) Mashua za matanga
3. Ukumbi wa mashua ulikuwa umejaa nini?
   - (a) Kamba
   - (b) Watu
   - (c) Maboksi
   - (d) Samaki

The cat brushed against the old man. He did not move. He only stood, staring up at the window of the house. The party inside looked warm and friendly, but no one noticed him. The old man walked sadly on, followed by the cat.

4. What kind of animal was following the old man?
   - (a) Mouse
   - (b) Dog
   - (c) Cat
   - (d) Bird

5. What was inside the house?
   - (a) A party
   - (b) Some dogs
   - (c) An old lady
   - (d) A meeting

6. The man is described as being
   - (a) Old
   - (b) Young
   - (c) Thin
   - (d) Small

Paka alikuwa anajigusagusa na yule baba mzee. Baba mwenyewe hakusogea, alisimama tu huku akikodolea kwenye dirisha la nyumba. Karamu iliyokuwa ndani ilionekana kuwa nzuri na ya kikarimu, lakini hakuna mtu aliyemwona. Mzee alijiendea kwa unyonge akifuatwa na yule paka.

4. Huyu mzee alifuatana na mnyama wa aina gani?
   - (a) Panya
   - (b) Mbwa
   - (c) Paka
   - (d) Ndege

5. Ndani ya nyumba kulikuwa na nini?
   - (a) Karamu
   - (b) Mbwa
   - (c) Mama mzee
   - (d) Mkutano

6. Huyo mwanamme anasemekana kwamba ni
   - (a) Mzee
   - (b) Kijana
   - (c) Mwembamba
   - (d) Mdogo

Directions: For questions 7–12, read the passage below. In each line, there is a box with four possible choices. Pick the choice that best completes the sentence in each numbered line. Mark the letter (a, b, c, or d) of the choice on your answer sheet.

7. Sound is something we
   - (a) hears.
   - (b) hearing.
   - (c) heard.
   - (d) hear.

It comes to your

8. (a) eyes
(b) nose
(c) ears
(d) mouth
in different ways. It might be pleasant,

9. like the voice of a friend,
(a) when
(b) as
(c) or
(d) since
unpleasant, like the *screech*

10. of a train's wheels on a railroad
(a) station.
(b) track.
(c) light.
(d) conductor.
Some sounds are loud,

11. and some are soft; some are high, and some are
(a) full.
(b) low
(c) quiet.
(d) big.
Sound is

12. very
(a) importance
(b) importantly
(c) important
(d) import
to us becaase it is the basic means of communications.

Questions 13–15 are also about the group of sentences above. Choose the best answer for each of these questions and mark it on your answer sheet.

13. What does *screech* in line 9 mean?
(a) noise (b) motion (c) place (d) piece

14. Which of the phrases below is another example of a pleasant sound, similar to the phrase in the sentence that begins in line 12, "like the voice of a friend"?
(a) Like the ring of an alarm
(b) Like the wail of a siren
(c) Like the honk of a horn
(d) Like the song of a bird

15. Which sentence below has almost the same meaning as the sentence that begins in line 14?
(a) It is meaningful to communicate with sound.
(b) The main way we communicate is with sound.
(c) The meaning of sound is basic to communication.
(d) In order to communicate, we need basic sounds.

Maelezo: Kwa maswali 7–12, soma fungu la maneno yafuatayo. Katika kila mstari kuna mapendekezo manne ndani ya mraba. Chagua pendekezo linalofaa kumalizia sentensi kwa kila mstari. Weka alama kwenye herufi (a, b, c, au d) kwenye karatasi ya majibu kufuatana na chaguo lako.

7. Sauti ni kitu ambacho Kinakuja
(a) husikiwa.
(b) sikia.
(c) tulisikia.
(d) twakisikia.

8. kwenye tkwa njia mbali mbali. Inaweza kuwa ya
(a) macho
(b) pua
(c) masikio
(d) mdomo

9. kuvutia, kama sauti ya rafiki,
(a) wakati
(b) kama
(c) au
(d) tangu

10. isiyo ya kuvutia, kama *mlio* wa kukwaruza, kama ule wa magurudumu ya gari moshi kwenye lizi ya reli. Sauti nyingine ni za
(a) stesheni
(b) njia
(c) taa
(d) mwanga

11. makelele, nyingine ni nyororo; nyingine ni za juu, na nyingine ni za Sautini
(a) kujaa.
(b) chini.
(c) kimya.
(d) kubwa.

12. sana kwetu kwa sababu ndiyo msingi wa mazungumzo.
(a) fahari
(b) kifahari
(c) muhimu
(d) maana

Masawali 13–15 pia yanahusika na mafungu ya sentensi za hapo juu. Chagua jibu linalofaa kwa kila swali halafu liwekee alama kwenye karatasi ya majibu.

13. Ni nini maana ya mlio wa kukwaruza kwenye mstari wa 14?
(a) sauti (b) mwendo (c) mahali (d) sehemu

14. Ipi kati ya misemo ifuatayo ni mfano mwingine wa sauti ya kuvutia, kama ilivyosemwa kwenye sentensi inayoanzia mstari wa 11, "kama sauti ya rafiki"
    (a) kama sauti ya kushtua
    (b) kama mlio wa kupaaza sauti
    (c) kama mlio wa honi
    (d) kama sauti ya ndege anapoimba

15. Ni ipi kati ya sentensi zifuatazo ina maana karibu sawa na sentensi iliyoanzia mstari wa 14?
    (a) Ni kitu cha maana kuzungumza na sauti.
    (b) Njia kuu ya kuzungumza ni kutumia sauti.
    (c) Maana ya sauti ni msingi wa mazungumzo.
    (d) Ili kuweza kuzungumza tunahitaji msingi wa sauti mbali mbali.

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Note: The questions have been renumbered, but they are in the same order as in the tests. The difficulty of the questions increases from the beginning to the end of the tests.

The tests appear to have been well calibrated; the frequency distributions of the test scores reveal considerable variance on each test, very few perfect scores, and no zero scores. The distribution of scores on Raven's test was similar in the two countries. This provides additional reassurance as to the test's validity as a measure of predetermined reasoning ability, since we have no reason to expect the distribution and level of intellectual capacity to differ between Kenya and Tanzania.

The Tested Subsample

This sort of testing is well outside the experience of most economists and to our knowledge was novel for East Africa. We did not know and could not predict how revealing the test results would be, nor could we be confident that people would readily agree to take the tests. The history of "intelligence tests" in Africa is not laudable, and suspicion and reluctance would not have been surprising. For these reasons, this part of the survey was regarded as being rather like a high-risk stock in a portfolio, with an uncertain yield and low probability attached to a high payoff. We had to be relatively risk averse and so could not allocate a large portion of our resources to the tests.

It was decided to limit the test to a subsample of workers that would be large enough to permit statistically significant inferences and generalizations. Because of the particular interest in the value of secondary education, testing was confined to primary and secondary completers. About 100 people who had precisely completed primary school (standard 7 or 8) and 100 who had precisely completed secondary school (form 4) were selected in each country. Selection was purposive; that is, a worker who was being interviewed and who fitted the educational criterion was selected for testing if a tester was available when the interview was completed. The sample was stratified because it was considered important to ensure adequate numbers in each educational category, and the number of primary and secondary completers in the samples was not known until the survey had been completed. As table C-1 shows, the subsamples are well representative of the larger samples from which they were drawn with respect to average wages, occupational distribution, and average experience.

The tests took an hour to administer. Testing was usually done by students who were studying educational psychology. Unexpectedly, workers showed enthusiasm for taking the tests and set to the tasks with diligence and determined care. The success of the results and the value of the data that they provide suggest that further work on these lines would be justified, in East Africa or elsewhere. Hindsight indicates that in our research, allocation of a larger portion of our resources to the tests to obtain a larger tested subsample would have been justified.

APPENDIX D

The Simulation Approach to Decomposing Inequality

IN THIS APPENDIX we describe a simulation method which we have used to decompose inequality of earnings (for instance, in chapter 3) or to conduct counterfactual experiments (for instance, in chapter 9). We argue that a simulation in which the estimated "true" relation determines the distribution of interest is often to be preferred to a commonly used alternative, the "comparative R^2" regression procedure.

Decompositions of measures of inequality are of interest for understanding the sources of inequality and the impact on inequality of various demographic, economic, and policy changes. Several authors have advocated and utilized a comparative R^2 regression procedure for identifying the relative contributions that different factors make to inequality of income (or of similar variables). Wise (1975, p. 359), for example, states:

> An idea of the relative contribution of academic versus nonacademic variables in the "determination" of salary may be obtained by comparing values of R^2 obtained when different groups of variables are included in the regression . . . A high estimate of the contribution of academic variables is the proportion of remaining variance explained when they are added to the regression in the absence of nonacademic variables; a low estimate is the addition to the proportions explained when they are added after the nonacademic variables.

Fields and Schultz (1980, pp. 458–62) use a similar procedure to establish bounds on regional and other contributions to income inequality.

We start with the comparative R^2 approach. We use ln income in this illustration because the log normal is a better approximation than the

Note: Adapted from J. R. Behrman, J. B. Knight, and R. H. Sabot, "A Simulation Alternative to the Comparative R^2 Approach to Decomposing Inequality," *Oxford Bulletin of Economics and Statistics* 45, no. 3 (August 1983), pp. 307–12.

normal for most empirical income (and related) distributions. Let the true relation determining ln income be

$$\text{(D-1)} \qquad Y = \sum_{i=0}^{n} a_i X_i + u$$

where Y is ln income, X_i is a set of independent variables with X_0 a constant, a_i are unknown parameters, and u is a stochastic term distributed independently of all X_i, with mean zero and constant variance σ_u^2.

The implied variance decomposition is

$$\text{(D-2)} \quad \sigma_Y^2 = \sum_{i=1}^{n} a_i^2 \sigma_{X_i}^2 + \sum_{i=1}^{n} \sum_{j \neq i} a_i a_j \sigma_{X_i X_j} + \sigma_u^2$$

The R^2 or coefficient of determination is the explained portion of the total variance:

$$\text{(D-3)} \quad R^2 = \left(\sum_{i=1}^{n} \hat{a}_i^2 \sigma_{X_i}^2 + \sum_{i=1}^{n} \sum_{j \neq i} \hat{a}_i \hat{a}_j \sigma_{X_i X_j} \right) / \sigma_Y^2 = 1 - \sigma_{\hat{u}}^2 / \sigma_Y^2$$

R^2 is weakly bounded by 0 (corrections for degrees of freedom being ignored) and 1.

Under the comparative R^2 procedure the "high" estimated contribution of a given variable is defined to be the coefficient of determination obtained if only that variable is included in the estimation of relation D-1 (that is, a_j is a priori set equal to zero for all $j \neq i$ except $j = 0$), and the "low" estimated contribution is defined to be the incremental addition to the coefficient of determination if the variable of interest is added to a specification that includes all other variables (that is, the restriction that a_i is zero is removed):

$$\text{(D-4a)} \qquad \text{“High” contribution} = R_i'^2$$

$$\text{(D-4b)} \qquad \text{“Low” contribution} = R^2 - R_i''^2$$

where R^2 is the coefficient of determination for relation D-1; $R_i'^2$is the coefficient of determination if only the *i*th variable is included; and $R_i''^{22}$ is the coefficient of determination if only the *i*th variable is excluded from relation D-1.

We use inverted commas around "high" and "low" because Hendry and Marshall (1983) show that the sum of the "high" contributions of the n right-hand variables need not exceed the sum of the "low" contributions. A reversal can occur if, for example, $R_i'^2$ is zero yet X_i is relevant to explaining Y, given the other Xs (or, more generally, if the partial correlation of X_i and Y exceeds the simple correlation). Obviously this result raises further questions about the comparative R^2 procedure.

The sum of the "high" contributions is not necessarily weakly greater than R^2, nor is the sum of the "low" contributions necessarily weakly less than R^2, although this is usually thought to be the case for earnings functions. The sums are equal to each other and equal to R^2 if and only if all the X_i variables are orthogonal. If n equals 2 (but generally only if n equals 2), the sum of the "high" estimate for one variable and the "low" one for the other equals R^2.

If relation D-1 is the true relation, an alternative approach is to estimate it directly and then to use those estimates to simulate the contribution of a given variable to the inequality measure of interest by hypothesizing a different distribution of the X_i variable of interest [illegible]ample, zero variance). If the inequality measure of interest is variance in ln income, relation D-2 can be used directly once the a_i and σ_i^2 have been estimated. In this case the contribution of a particular X_i to σ^2, can be identified with the sum of all terms in relation D-2 that involve the variance or covariance of X_i.

When some other measure of inequality is employed, the estimated relation D-2 is used to predict the ln income of each person, $\widehat{Y}$. Everyone's endowment of each X_i is in turn set equal to the mean value of X_i for the sample as a whole, and the predicted ln income, $\widehat{Y}_i$, of each person is calculated with the use of the estimated function with the hypothetical mean value for X_i. The inequalities of $\widehat{Y}$ and $\widehat{Y}_i$ are calculated as $I(\widehat{Y})$ and $I(\widehat{Y}_i)$, and the contribution of each X_i to inequality is estimated as $I(\widehat{Y}) - I(\widehat{Y}_i)$.

The relative contribution of each X_i is obtained by expressing its contribution as a percentage of

$$\sum_i [I(\widehat{Y}) - I(\widehat{Y}_i)]$$

In effect, the following counterfactual question is being asked: what would be the impact on inequality if the dispersions attributable to each determining characteristic were eliminated in turn?

A second counterfactual question might be: what would be the impact on inequality if the dispersions attributable to all determining characteristics except one were eliminated in turn? Where $I(\widehat{Y}_i')$ is the inequality attributable to X_i alone, the relative contribution of X_i is $I(\widehat{Y}_i')/\Sigma_i\ I(\widehat{Y}_i')$.

The answer to the first counterfactual question is analogous to the "low" contribution in the comparative R^2 approach and the answer to the second counterfactual question is analogous to the "high" contribution. In general, the answers to the two counterfactual questions do not give the same decompositions of inequality even if the X_i are orthogonal (although in this case, as noted above, the "high" and "low" contributions are the same).[1]

The contribution of X_i based on any of the simulations is dependent in general on all parameter values, the distribution of the particular X_i, and the distributions of all other X_i (through the covariances or other interactions). The sum of the contributions of all $X_i (i = 1, \ldots n)$ so calculated is generally not equal to R^2, even if the inequality measure of interest is variance ln income, because of the double role of the covariance terms. That is, the covariance between X_i and X_j affects the contribution so measured of both X_i and X_j. If and only if all of the X_i are orthogonal to one another is the sum of these contributions equal to R^2 for the variance ln income inequality measure. For other inequality measures, even if the X_i are orthogonal to one another, the sum of the contributions of all X_i may not be R^2.

If the measure of inequality that is of interest is variance ln income and if all of the X_i are orthogonal, the two approaches give identical decompositions of the sources of inequality. Otherwise they may give different decompositions. The simulation alternative seems preferable in five respects.

First, the usual comparative R^2 approach is informative only if the measure of inequality that is of interest is variance ln income and not if other measures (for example, the Gini coefficient and Theil's inequality index) are of greater interest. In contrast, the simulation approach may be used with any desired measure of inequality, and the relative contribution of a variable may differ depending on which measure of inequality is employed.

Second, the comparative R^2 approach simply shows the total contribution to σ_Y^2 made by each X_i. Even if variance ln income is the inequality measure of interest, at times it may be of more interest to ask what would happen to σ_Y^2 if there were some change in the distribution of X_i other than the elimination of all variance in it. For example, it may be of interest to ask what would be the impact on variance ln income of halving the variance in years of schooling. Such questions are straightforwardly answered with the simulation approach, but the comparative R^2 procedure cannot answer them.

Third, although collinearity among the independent variables presents a problem for both approaches—for the simulation approach the problem is that less reliance can be placed on the estimated coefficients—the simulation approach permits the establishment of confidence intervals for the contribution of a given X_i to inequality. The variance-covariance matrix of parameter estimates can be used to obtain the probabilistic distribution of the contribution of a given X_i. In contrast, the comparative R^2 does not give confidence intervals. The "high" and "low" values obtained in the comparative R^2 procedure are not related to confidence intervals, although sometimes they are inappropriately discussed as though they have some such relation.

Fourth, the simulation approach builds on the hypothesized structural relation and explicitly incorporates the dependence of a given decomposition on the distributions of all parameters and of all right hand variables. Given the assumed true structure, the decomposition estimates obtained are based on unbiased parameter values. The comparative R^2 approach, in contrast, uses parameter estimates that are biased if relation D-1 is indeed the true relation. The procedure for obtaining the "high" contribution, for example, uses parameter estimates that are generally biased owing to the omission of variables from the true structural relation. Under the maintained hypothesis regarding the true relation, it is not at all clear why the implications of the particular misspecification used in this "high" value calculation are of any particular interest.[2]

Fifth, in the case of the variance ln income measure, the simulation alternative is easier since only one regression need be estimated instead of $2n + 1$ regressions. In the case of other measures, one regression and n simulations are required.

The simulation procedure can also be used in counterfactual experiments to examine the effect of hypothetical policy changes on inequality. (Recent examples for developing countries include Wolfe, Behrman, and Blau 1982 and Knight and Sabot 1983a.) For instance, it is possible to measure the effect on income inequality of increasing to the minimum level all schooling levels that are below some minimum (see Blaug, Dougherty, and Psacharopoulos 1982). Similarly, it may be of interest to examine the effect on inequality of the change in the educational composition of the labor force or in the schooling coefficient brought about by a policy of educational expansion.

In chapter 9, for instance, we estimate an equation corresponding to D-1 to predict the earnings of each worker. It is then possible to calculate the inequality of predicted earnings. We simulate the effect on the earnings structure of altering the relative supply of educated labor by substituting the set of education coefficients of one country for those of the other and again predicting individual earnings and hence the inequality of those earnings. Similarly, we simulate the effect on the labor force composition of altering the relative supply of educated labor. The educational composition of one sample is substituted for that of the other, and the inequality of predicted earnings of the reweighted sample is calculated. A further exercise combines these two effects of educational expansion.

A limitation of the simulation approach should be recognized, however. The counterfactual questions require that the coefficients a_i be invariant with respect to changes in the distribution of the determining variables X_i. Yet these coefficients might alter in response to the assumed exogenous change, as might the values of the other Xs. It is necessary, therefore, to avoid simulations if theory clearly predicts an ensuing change in what are treated as parameters.

Notes

1. In general, the various X_i interact multiplicatively in inequality measures (although not in relation D-1). Therefore even if their covariances are zero, there remains a problem of attribution for the interaction terms akin to the covariance in relation D-3, which leads to different decompositions for the two counterfactual questions.

2. Of course, the maintained hypothesis regarding the true structure may be wrong in an infinite number of ways, and one interpretation of the "high" value in the comparative R^2 procedure is that it is the outcome if the true specification differs from the assumed one in specific ways. But why focus on that particular possibility? Relation D-1 may be misspecified in ways that lead to underrepresenting or overrepresenting the contribution of X_i to σ_Y^2.

APPENDIX E

Classification of Occupations

IN MOST LABOR FORCE SURVEYS the classification of occupations is not conceptually appropriate—it tends to be a murky blend of activity, skill, and status—and the system of classification cannot be relied on to be consistent from one survey to another. To avoid these faults, considerable care was taken with the treatment of occupation in the Kenyan and Tanzanian surveys. It was necessary to work from first principles, and so the skill content of the job was explicitly used as the criterion for classification. To this end a specially designed occupational questionnaire was administered to the respondent by the interviewer at the appropriate stage of the main interview (figure E-1).

Information was obtained not only on the current wage job but also on the previous wage job and on the first wage job (if these differed). If the respondent had changed occupation during the tenure of the job, the latest information was obtained in each case. Hindsight shows that, given the importance of occupation in our analysis, it would have been worthwhile to document changes in occupation during the tenure of each job. As it is, however, we have more information, and conceptually more appropriate information, on occupation than is normally the case with labor market surveys.

The interviewer asked not only what the job was called but also what tasks were performed. For instance, a worker who described himself as a machine operator would be asked what type of machinery was used, whether it was automatic, semiautomatic, or manual, whether it was used for one operation only; and whether he set it himself, operated it alone, or had or was an assistant. The respondent was asked about his position in the supervisory hierarchy. He was asked how long it had taken him to become fully proficient in the job and about the nature and length of training that had been relevant to the job. The classification of workers into occupations was precisely the same for both countries. It was done—after the interviews but before analysis of the survey data—by the researchers on the basis of a consistent set of criteria for establishing skill level. These criteria did not include the wage or the educational attainment of the worker.

Figure E-1. *Occupational Questionnaire: Job Description*

Employee number:
Firm number:
Interviewer number:

Question	Current job	Last job	First job
What is the job called?			
Describe it carefully:			
What exactly do you do?			
Do you do different tasks? (Mention the main one but also the others.)			
If you work with machinery:			
Name the machine(s)			
What does it/they do?			
Automatic, semiautomatic, or manual?			
Is it used for one operation only?			
Do you set it?			
Do you operate it? or,			
Do you help to operate it?			
Do you have supervisory responsibilities?			
If so, how many people are you in charge of?			
Who is in charge of you?			
Are you an assistant to someone? What post?			
How long did it take you to become fully proficient?			
What training was necessary for the job?			
Nature of training?			
Length of training?			

Although finer classifications were made (table E-1, part A), respondents were also placed in six broad occupational groups (part B): unskilled manual (O_5), semiskilled manual (O_4), skilled manual (O_3), junior clerical (O_{2b}), senior clerical (O_{2a}), and supervisory (O_1). These are the groupings that we have generally employed in the empirical analysis of occupation. A relevant trade certificate was normally decisive in placing a manual worker in the skilled category. Other pointers to this category were a long period (four or more years) of training on the job; operation and setting of complicated machinery; supervision of other machine operators; and a lengthy period (three months or more) of relevant full-time formal training. Indicators of semiskilled status were: no relevant trade test; two months (minimum) to four years of experience needed for proficiency on the job; operation of a machine or operation and setting of a simple machine; being an assistant to a skilled worker; and a short period (less than three months) of formal training. Indicators for the unskilled classification were: proficiency in the job within two months; simple repetitive tasks; close supervision and little autonomy; and no relevant formal training. The clerical category (clerical, accounts, secretarial, and sales workers) was subdivided into senior and junior groups according to the levels of skill and authority involved in the job. For instance, the (smaller) senior group included clerical supervisor but not clerk or clerical assistant; noncertified accountant and head bookkeeper but not bookkeeper or assistant bookkeeper; and personal secretary but not typist. The category of other nonmanual workers included technical and semiprofessional, managerial, administrative, and professional workers.

Table E-1. *Occupational Codes*

A. Occupations

Manual

1. Unskilled (100)

101	Laborer, general
102	Laborer, factory
103	Laborer, farm
104	Laborer, other
105	Cleaner
106	Dishwasher
107	Driver's mate
108	Gardener
109	Machine operator's assistant
110	Messenger
111	Porter
112	Sweeper
113	Watchman

(*Table continues on the following page.*)

Table E-1 (*continued*)

2.	Semiskilled (200)
201	Machine operator, general, semiskilled
202	Machine operator, factory, semiskilled
203	Machine operator, farm, semiskilled
204	Machine operator, other, semiskilled
205	Artisan's mate
206	Assistant cook
207	Barber, hairdresser
208	Barman
209	Bus conductor
210	Driver, light vehicle
211	Driver, simple machines (for example, forklift)
212	Domestic servant
213	Factory assembler, semiskilled
214	Housekeeper
215	Petrol pump attendant
216	Waiter
217	Factory worker, semiskilled
218	Head messenger
219	Caretaker
220	Butcher, semiskilled
3.	Skilled (300)
301	Machine operator, general, skilled
302	Machine operator, factory, skilled
303	Machine operator, farm, skilled
304	Machine operator, other, skilled
305	Blacksmith
306	Boilermaker
307	Bricklayer, mason
308	Carpenter
309	Chef
310	Compositor
311	Dressmaker
312	Driver, heavy vehicles
313	Driver, complicated machinery (for example, bulldozer)
314	Electrician
315	Fitter
316	Flamecutter
317	Foreman
318	Headman
319	Head barman
320	Head cleaner
321	Head steward
322	Head waiter
323	Instrument maker
324	Joiner
325	Machine setter
326	Mechanic, motor
327	Mechanic, other
328	Painter
329	Polisher

- 330 Pipefitter
- 331 Plumber
- 332 Printer
- 333 Stonemason
- 334 Tailor
- 335 Toolmaker
- 336 Toolsetter
- 337 Welder
- 338 Panel beater
- 339 Coach builder
- 340 Foundry worker, skilled
- 341 Other skilled artisan
- 342 Butcher, skilled

Nonmanual

4. Clerical and related (400)
   - 401 Clerical supervisor
   - 402 Clerk, general function
   - 403 Clerk, single function
   - 404 Clerical assistant
   - 405 Data machine operator

   Accounts
   - 411 Noncertified accountant
   - 412 Head bookkeeper
   - 413 Bookkeeper, general
   - 414 Bookkeeper, single function (for example, wages clerk)
   - 415 Assistant bookkeeper
   - 416 Chief cashier
   - 417 Cashier
   - 418 Assistant cashier
   - 419 Business machine operator
   - 420 Head storekeeper
   - 421 Storekeeper
   - 422 Assistant storekeeper

   Secretarial
   - 431 Personal secretary
   - 432 Stenographer
   - 433 Shorthand typist
   - 434 Copy typist

   Sales
   - 441 Sales supervisor
   - 442 Buyer, salesman
   - 443 Sales assistant
5. Technical and semiprofessional (500)
   - 501 Agricultural extension worker
   - 502 Agricultural instructor
   - 503 Agronomist, semiprofessional
   - 504 Dental technician
   - 505 Draftsman

(*Table continues on the following page.*)

Table E-1 (*continued*)

506	Engineering technician
507	Library assistant
508	Medical assistant
509	Nurse and midwife, professional
510	Nurse and midwife, enrolled
511	Pharmaceutical technician
512	Photographer
513	Physiotherapist
514	Science technician
515	Statistical and computing technician
516	Surveyor
517	Watch and clock repairer
518	Clerk of works
519	Other semiprofessional
6.	Managerial and administrative (600)
601	Government administrative officer
602	Government executive officer
603	General manager
604	Production manager
605	Specialized manager
606	Farm manager
607	Assistant manager
7.	Professional (700)
701	Accountant, professional
702	Actuary
703	Agronomist, professional
704	Aircraft pilot, navigator
705	Architect
706	Auditor
707	Author
708	Dentist
709	Doctor
710	Economist
711	Engineer, civil
712	Engineer, chemical
713	Engineer, electrical
714	Engineer, mechanical
715	Engineer, other
716	Journalist
717	Jurist
718	Lawyer
719	Librarian
720	Pharmacist
721	Priest
722	Quantity surveyor
723	Scientist
724	Statistician
725	Teacher, university level
726	Teacher, other postsecondary

727 Teacher, secondary level
728 Teacher, primary level
729 Teacher, preprimary level
730 Teacher, special education
731 Town planner
732 Veterinarian
733 Teacher, untrained temporary
734 Computer scientist

8. Law and order (800)

801 Soldier
802 Sailor
803 Policeman
804 Warder

9. No reply (999)

B. Occupational groups and corresponding codes

Unskilled manual (O_5):	101–13
Semiskilled manual (O_4):	201–20
Skilled manual (O_3):	301–42
Junior clerical (O_{2b}):	402–05, 413–15, 417–19, 421, 422, 432–34, 442–43
Senior clerical (O_{2a}):	401, 411, 412, 416, 420, 431, 441
Supervisory (O_1):	501–19, 601–07, 701–34

Note: No respondents were currently in the law and order category (801–04).

APPENDIX F

The Theory of the Occupational Production Function

THE NOTION OF THE OCCUPATIONAL PRODUCTION FUNCTION was introduced by Knight (1979) to show, for each occupation *i*, a relation between a worker's years of education, *E*, and his productivity, *Y*. Figure F-1 shows the occupational production function, Y_1, for occupation 1. The function is shown on the assumption that inputs of other factors are held constant or are optimized at each level of *E*. Below some minimum level of E_1 productivity in occupation 1 is zero. As education is raised above E_1, productivity increases. Beyond E_3 the curve becomes horizontal; further years of education have no effect on productivity. A second occupation may have a production function—for example, Y_2—with similar characteristics but a different position and slope.

The benefits of additional education may differ among occupations for two reasons. First, the cognitive skill acquired in education may simply be of more value in some occupations than in others. Second, education may itself be an argument in the production function of postschool human capital formation, and some occupations may involve greater vocational skill formation than others. A general model of the determinants of occupation-specific productivity might be expressed as:

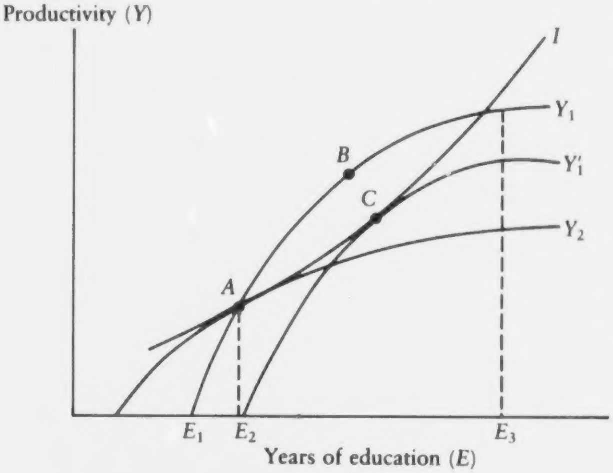
$$Y_i = Y_i\,(E, V, E \cdot V, R, R \cdot V) \tag{F-1}$$

where *V* represents training—that is, postschool formal and informal vocational skill acquisition; $E \cdot V$ is an interaction term denoting that the effect of training on productivity depends positively on years of schooling; *R* represents predetermined ability; and $R \cdot V$ is another interaction term.

These relationships are most clearly analyzed one at a time before being drawn together. We therefore concentrate initially on the first term, *E*; that is, we assume that cognitive skill acquired in school influences productivity within an occupation, that vocational skill formation does not occur, and that ability has no influence.

In a fully competitive market economy there is a certain relationship

Figure F-1. *The Occupational Production Function*



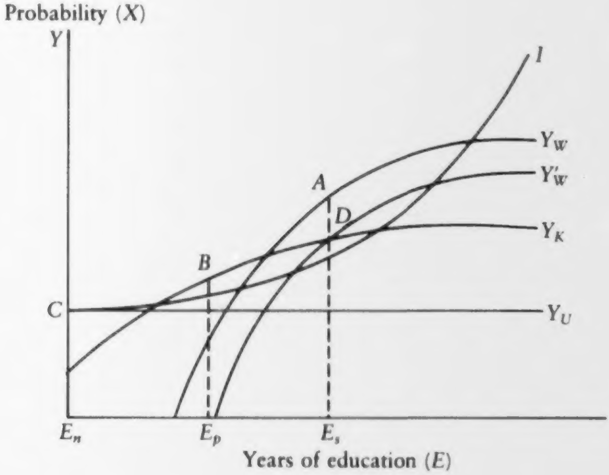
between years of education and productivity (Mincer 1974, ch. 1). For identical individuals there is a single semilogarithmic relationship between E and Y, irrespective of occupation, that shows the combinations of E and Y for which the rate of return on education equals the rate of discount. The notion of an occupational production function is, however, perfectly consistent with competitive theory. At the point of tangency (A) between I and Y_2 in figure F-1, the individual is content with the income associated with education E_2 in the sense that the rate of return equals his rate of discount. He is better off, however, at (say) B on Y_1, which is above I: point B is chosen. On the assumption that all individuals have identical economic characteristics (that is, I, Y_1, and Y_2 are the same for everyone), an inflow of persons into occupation 1 takes place and depresses the wage. The lower wage encourages the employment of this occupation in two ways, one technical and the other through the market. First, there are diminishing returns to numbers employed in an occupation. Second, if manufacture of a product makes intensive use of the occupation, the relative price of that product will fall. Factors are substituted until the marginal product of occupation 1 falls to equal the wage. This decrease in the marginal product of the occupation shifts the entire curve Y_1 downward to Y_1' such that Y_1' touches I at C. Point C is the new equilibrium combination of education, productivity, and wage in occupation 1.

By an extension of this reasoning it can be seen that the indifference curve I, which is common to all individuals, forms an envelope of all occupational production functions (also common to all individuals). The optimal amount of education in any occupation is given by the condition that the occupational production function must be tangential to the indifference curve. In a perfectly competitive labor market, occupational production functions that involve more education could remain above curve *I* only if there were educational rationing.

The effect of capital market imperfections is to raise occupational production functions at the upper, rationed levels of education. The effect of labor market imperfections can be explored by comparing the consequences of educational expansion under conditions of wage flexibility and wage rigidity. We examine the way in which the labor market adjusts to educational expansion within two models of the labor market: flexible wage (wage competition) and rigid wage (job competition). The educational expansion is assumed to begin from a situation of educational rationing because, for instance, capital market imperfections are removed. The expected consequences of expansion are the filtering down of educated labor into lesser occupations or—the reverse of the coin—the upgrading of the educational requirements for holding particular jobs.

To simplify, assume that there are only three levels of education: *n* (no education), *p* (primary), and *s* (secondary), and only three occupations, *W* (white collar), *K* (skilled), and *U* (unskilled). The three occupational production functions are illustrated in figure F-2, in which the three educational levels (entry points to the labor market) are on the horizontal axis. Initially those with education E_s are employed in occupation *W* with

Figure F-2. *Occupational Production Functions with Educational Rationing and Educational Expansion*



production function Y_W, those with E_p in K, and those with E_n in U, where productivity is independent of education (Y_U is horizontal). In a competitive economy workers are paid their marginal products: wages correspond to points A, B, and C, respectively. The curve I is assumed to pass through C but to run below points A and B—that is, educational rationing is in force. Now assume an exogenous increase in the stock of people with E_s and a corresponding decrease in the number with E_n. This is best analyzed in terms of W, K, E_s, and E_p.

Consider first the case of wage flexibility. The increased supply of workers with E_s depresses the wage in W. As the wage falls, employment in W increases in response to factor substitution. Workers with E_s are taken into occupation W until the wage falls to a level corresponding to D, the wage available to them in occupation K. They are then prepared to enter employment at the same wage in K. Thus there is a filtering down of some E_s workers into the next inferior occupation, but all E_s workers receive the same wage. Employers are indifferent between paying E_p workers a wage corresponding to B and E_s workers a wage corresponding to D, as the wage difference corresponds precisely to the productivity difference in occupation W. The process need not stop at that. The filtering down of persons with education E_s into occupation K increases the supply of K workers. Precisely the same analysis as that for W and K can be applied to K and U, the next inferior occupation. The supply increases, the wage falls, and a filtering down of E_p workers into occupation U may occur.

We now analyze the effect of an expansion of the stock of labor with E_s under a quite different assumption, that of occupational wage rigidity. The wages of W, K, and U workers are fixed; those of W and K workers are shown as A and B in figure F-2. Wage rigidity may arise because the incumbents of posts possess job security, or both wage rigidity and job security may be associated with an internal labor market. Alternatively, wage rigidity may exist without there being job security. If there is job security, the incumbents of existing posts are protected against the new E_s entrants. Only labor turnover and the expansion of employment enable E_s workers to become employed on entering the labor market. In this way some are employed in W jobs and the rest receive preferential access to lesser jobs as these become available. In the absence of job security the new E_s workers are in a lottery for the limited W jobs. Those who do not draw a W job in the lottery are given preference in K posts, since they are more productive than the E_p workers ($D > B$) but receive the same wage, B. This creates a surplus of workers possessing E_p who in turn receive preference in U posts, and so on down.

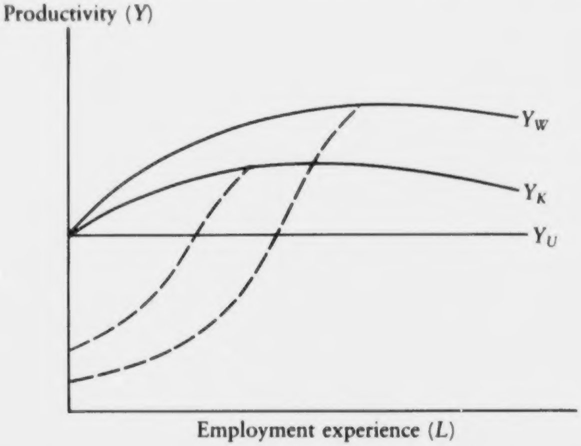
The relevant contrast between these cases is as follows. Even in competitive factor markets, workers have a preference ordering among occupations; there will be a particular occupation in which a worker of a certain educational attainment is more productive than in any other (figure F-1). If capital markets are imperfect but labor markets are perfect, all workers with the same education will tend to be paid the same wage even if they are in different occupations (figure F-2). If differences in tastes and in job satisfaction are ignored, the implication is that these workers do not have a preference ordering among these occupations. In the rigid wage (job competition) case, by contrast, workers of the same education can receive different pay in different occupations and therefore have preferences among these occupations. Even in the flexible wage (wage competition) model, employers have preferences in recruiting to occupations; competitive wages for workers of different education determine which level of education is most profitable in each occupation (figure F-1). But if wage rigidity means that the wage varies less with education within occupations than it does among occupations, employers have reason to recruit the most educated workers available (figure F-2).

Let us withdraw the first assumption—that the cognitive skill acquired in education is of more value in some jobs than in others—and replace it with the second—that education is itself an argument in the production function of vocational skill formation and that some occupations involve greater vocational skill formation than others. We thus concentrate on the terms V and $E \cdot V$ in equation F-1. Assume that vocational skills are marketable and therefore, although occupation-specific, are general rather than firm-specific. In that case it is the employee who benefits from and pays for the skill formation. The wage-experience profile can be expected to take the normal inverted-U-shaped form: the wage falls short of productivity during training and subsequently equals it, and productivity rises in early career as skills accumulate and falls in late career as they are lost or become obsolescent.

Let us proceed by stages, initially ignoring the interaction term $E \cdot V$. Figure F-3 shows productivity (the continuous lines) against length of employment experience (L) for the three occupations. In the unskilled occupation (U) there is no vocational skill formation; the wage and productivity are equal and unchanging throughout. In the skilled (K) and white-collar (W) occupations skill formation occurs—more in W than in K—and the wage (the dashed lines) therefore falls short of productivity during the period of employer-provided training on the job. Given competitive capital markets and free mobility of labor, discounted lifetime earnings are independent of the amount of vocational skill acquisition and are the same in different occupations. Only if there are capital market imperfections and therefore rationing of training are the more skilled occupations prized on account of the greater skills that they provide.

Consider the influence of education on vocational skill formation. As-

Figure F-3. *Vocational Skill Formation, Wages, and Productivity*



sume initially that each occupation involves a fixed amount of vocational skill. In that case the cognitive skill derived from education, by making acquisition of vocational skills more efficient, simply reduces the amount of training needed to achieve the fixed amount of vocational skill. Education therefore has no effect on the productivity of a trained worker; each occupational production function that relates Y to E is horizontal, although each is at a different level of productivity. It becomes profitable for the more educated to enter occupations that involve more vocational skill because their training will be less costly.

Now assume that the amount of vocational skill differs within as well as among occupations. Within an occupation the possession of education makes it profitable to invest in more vocational skills. Each occupational production function therefore has an upward-sloping range, as in figure F-1. The educated have higher productivity both because of the amount of skill inherent in the occupations that they choose and because of the amount of training that they choose within occupations.

We now reintroduce the assumption that cognitive skill is itself valuable in the performance of a job and more valuable in some jobs than in others. When we bring into play all three terms—E, V, and $E \cdot V$—in the occupational production function specified in equation F-1, we find that figure F-1 remains relevant. Given perfect capital markets, the net present value of vocational skills is zero. Provided that wages are regarded as discounted lifetime income, the equilibrium tangency properties of figure F-1 still hold. The current wage of trained workers, however, will be above the indifference curve to the extent that vocational skills are rewarded. The higher a trained worker's educational attainment, the higher his wage, owing to choice both of occupation and of training within an occupation. Moreover, if the capital market is imperfect and vocational training is rationed, this provides a further reason why occupation can have an independent influence on wages.

It is necessary to recognize that ability also influences productivity in an occupation and that it may have a greater influence in some occupations than in others. Its influence is shown by the terms R and $R \cdot V$ in equation F-1. The term $R \cdot V$ comes into play if ability, like education, alters the efficiency with which training can be converted into vocational skills. A further complication can arise from a correlation between ability and educational attainment. On the assumption that ability influences the efficiency with which schooling can be converted into cognitive skills, R and E are likely to be positively correlated in meritocratic educational systems. The term E should then be written as $E(R)$ and $E \cdot V$ as $E(R) \cdot V$ in equation F-1. As a consequence the more able have an incentive not only to become more educated but also, since they are more educated, to enter occupations that involve more vocational skills and to acquire more vocational skills within an occupation.

We may draw some conclusions from this analysis. Ignore for the moment the fact of occupation-specific vocational skill acquisition. In that case, although occupational production functions are consistent with competitive factor markets, they would be a useful analytical tool only in the presence of capital and labor market imperfections. This is, of course, not a serious limitation, especially in developing countries. Now that choice-theoretic explanations for factor market imperfections are being developed, economists are less reluctant to incorporate failure or tardiness of factor market clearing into their analyses (for example, Schultze 1985). Capital market inflexibility can mean that workers prize education, and labor market inflexibility can mean that workers prize certain occupations. But when occupation-specific vocational skills are incorporated into the analysis, occupation can be expected to influence (current) wages even when factor markets are competitive. Occupational production functions, in their most general form, imply a nexus of relationships between occupation, education, ability, cognitive skill, vocational skills, and productivity. Education assists vocational skill acquisition, so encouraging the more educated—who are likely also to be the more able—to seek out those occupations that involve more vocational skills and to acquire more vocational skills within occupations. Thus education raises productivity through its effect on choice of occupation and through its effects via cognitive and vocational skills within an occupation. If capital market imperfections cause vocational skills to be rationed, there is a further reason for workers to prize skill-intensive occupations. If labor market imperfections mean that there is a wage for the job irrespective of individual productivity, the occupational production function predicts that employers will prefer to employ workers with more education.

APPENDIX G

The Public-Private Wage Differential: Tanzania 1971

IN THIS APPENDIX we use data from a 1971 household survey to determine the pattern of wage differences across employer groups. The analysis provides a basis for comparing the public-private wage differential in Tanzania at the beginning of the 1970s, soon after the adoption by the government of a compressive pay policy, and, using establishment surveys, in 1980, after the policy had had ample time to take effect.

The issue of public versus private compensation has not received as much attention in high-income economies as, for example, wage differentials between union and nonunion establishments. In the United States this is because the prevailing wage rate model has been used to determine and hence to explain government pay scales. The government is viewed as just another price taker that accepts a market-determined rate. In a perfectly competitive labor market, group affiliation does not influence wages. Irrespective of differences among groups of workers in goods produced, in the technology or organization used to produce them, in the profitability of such production, or in the ownership of the establishments in which they work, competition in the labor market will ensure that all workers with the same personal economic characteristics and preferences for work activity receive the same rate of pay. If public-private wage differences occur, they are generally interpreted in the competitive model as attributable to short-run adjustment problems or to lags in government wage movements.

Group affiliation matters only if nonmarket forces are sufficiently powerful to prevent competition in the market from eroding differentials among homogeneous workers. The public sector holds a commanding position in the labor markets of many developing countries. It is not uncommon to find more than half of all wage earners in the employ of the gov-

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Note: Adapted from D. L. Lindauer and R. H. Sabot, "The Public/Private Wage Differential in a Poor Urban Economy," *Journal of Development Economics* 12, nos. 1–2 (February–April 1983), pp. 137–52.

ernment or of parastatal enterprises. Moreover, not all governments of developing countries choose (or are in a position to choose) the prevailing wage model in setting their pay scales. Government pay policies are often influenced by distributional, fiscal, employment, or political goals. There is evidence, for example, that in Tanzania colonial wage and salary structures, which were geared to the supply prices of Europeans, were not dismantled at independence because to do away with what many regarded as the fruits of independence would have been politically untenable (see Sabot 1979, p. 210). In sum, in many low-income countries the public sector does not have the need, the desire, or even the ability to act as a wage taker.

To study the relationship of public to private wages, data for this analysis were obtained from the 1971 National Urban Mobility, Employment, and Income Survey of Tanzania (NUMEIST), which was conducted by Sabot. A random sample of households in Dar es Salaam and six other urban areas was surveyed. Over 5,000 individuals, including 1,500 African male regular wage earners, were included in the sample.[1] Respondents provided information on their monthly earnings, nonwage benefits, education, employment history, and other personal characteristics. Roughly one-third of the sample fell into each employment category—private, government, and parastatal enterprises.[2]

Our first measurement is of the differences in mean wages between government and private sector employees, between parastatal and private sector employees, and between parastatal and government employees. Both $G = \overline{W}_a - \overline{W}_b$, the absolute difference, and $\alpha = (\overline{W}_a - \overline{W}_b)/\overline{W}_b$, the relative difference, are presented; $\overline{W}_a$ represents the mean wage of the high-paid group. Measures of G disaggregated by occupation are also presented, and hypotheses are suggested to explain the public-private differences that remain. We go on to contrast α with the value of β, where β represents the average percentage by which the pay of group *a* exceeds that of group *b* after various personal characteristics of the wage labor force are standardized. Standardization is performed by estimating a simple wage function of the general form $\ln W = f(\mathbf{X})$, where the log of monthly earnings of urban wage earners is the dependent variable and $\mathbf{X}$ is a vector of personal characteristics. In addition to those characteristics generally found to be good predictors of earnings, dummy variables for ownership category of the worker's employer are included. The only other additional feature of the specification is a variable that indicates whether the worker was employed in Dar es Salaam or in one of the six smaller towns included in the sample. β is derived from the coefficient on the ownership dummy denoting group *a* (the high-paid group, with group *b* as the base category) in the earnings function for the full sample (see Halvorsen and Palmquist 1980).

In an aggregate earnings function, such as this, where the coefficients on the independent variables are constrained to be the same for all ownership groups, β can be a misleading indicator of the magnitude of standardized wage differences among ownership groups if there are marked differences in the wage structure among parastatals, the government, and private enterprises—that is, in the coefficients of separate earnings functions. Therefore we go on to examine the nature and degree of differences in the structure of earnings among ownership categories. The following stratified regressions are estimated and subjected to a series of Chow tests:

$$\ln W_{Go} = f(\mathbf{X}_{Go}); \quad \ln W_{Pr} = f(\mathbf{X}_{Pr}); \quad \ln W_{Pa} = f(\mathbf{X}_{Pa})$$

where Go = government, Pr = private, Pa = parastatal, and $\mathbf{X}$ is a vector of independent variables that in this case exclude the ownership dummies. These tests do not allow us to determine whether differences among stratified regressions are attributable to differences in slopes or in intercept terms. Therefore we also estimate an interactive version of our aggregate earnings function, that is,

$$\text{(G-1)} \qquad \ln W = a + b\mathbf{X} + c(\mathbf{X} \cdot Go) + d(\mathbf{X} \cdot Pa) + u$$

where a is the constant and b, c, and d are coefficients that measure, respectively, the impact of the independent variables on earnings in the private sector, the incremental impact of those variables for government workers, and the incremental impact of those variables for workers in the parastatal sector.

Having specified and measured as best we can the differences among private, government, and parastatal establishments in the level and slopes of their earnings functions, we decompose the gross wage differences to measure the impact of these differences on the earnings of representative workers from each of the ownership categories. The representative workers are constructs; the characteristics of the government worker, for example, are given by the mean value for all government workers of each of the independent variables. For each of the three representative workers we use the stratified wage functions to predict, given their characteristics, what they would be paid in the other two ownership categories. Our procedure, which is a simple form of simulation analysis, has been widely used in the analysis of labor market discrimination in high-income countries (see Blinder 1973 and Malkiel and Malkiel 1973) and is beginning to be applied in low-income countries (see Behrman and Wolfe forthcoming, Birdsall and Fox 1985, and Knight and Sabot 1982). In effect, we decompose the gross wage differences among ownership categories into E, the parts "explained" by differences in the characteristics of the labor forces among the categories, and R, the unexplained residual that reflects differences in wage functions.

In explaining the method we focus on government and private sector employees. We assume that the mean wage of government workers is determined by the earnings function $\overline{W}_a = f_a(\bar{\mathbf{X}}_a)$, where $\bar{\mathbf{X}}_a$ are the mean values of a vector of characteristics. The mean wage that private sector employees would receive if they were paid according to the government wage structure is $f_a(\bar{\mathbf{X}}_b)$. The gross wage difference between sectors is then decomposed as follows:

$$G = \overline{W}_a - \overline{W}_b = [\overline{W}_a - f_a(\bar{\mathbf{X}}_b)] + [f_a(\bar{\mathbf{X}}_b) - \overline{W}_b] = E + R$$

A similar decomposition is obtained by substituting $f_b(\bar{\mathbf{X}}_a)$ for $f_a(\bar{\mathbf{X}}_b)$, the wage that would be received by government workers if they were paid according to the private sector wage structure. The procedure allows us to answer as best we can the fundamental question addressed by this appendix: how much of the observed differences in mean earnings among ownership categories is attributable simply to differences in composition and how much to various nonmarket forces that drive a wedge among pay levels in different employer categories for workers with the same characteristics?

Gross and Standardized Wage Differences

Table G-1 shows that in 1971 government urban employees earned 133 shillings (51 percent) more and parastatal employees 146 shillings (56 percent) more than employees in privately owned establishments.[1] Table G-2, however, indicates that, as is usual, labor demand is much more skill-intensive in the government sector than in the private sector. Because of these differences in composition, the government-private differential for particular occupations is much less than the differential in mean earnings. Indeed, table G-1 indicates that in six of eleven occupational categories the earnings advantage is to private firms. If the private sector had the occupational composition of the government, the remaining differential in mean earnings would be only 16 percent and would be almost entirely attributable to the higher salaries of managers in the government than in the private sector.

With respect to skill intensity, the parastatal sector falls between the other two, and therefore differences in occupational composition do not explain as much of the parastatal-private as of the government-private gross wage difference. Parastatal earnings are higher in ten of the eleven occupational categories. If the parastatal sector had the occupational composition of the government, the difference in mean wages between the sectors would remain a substantial 23 percent.

The observed differentials may in part represent differences in the characteristics of specific jobs. No occupational standardization can ever account for all the variations in working conditions, security of job tenure, and risk in different work activities. Even within a competitive environ-

Table G-1. *Earnings of African Male Employees, by Occupation and by Ownership Category, Tanzania 1971*
(shillings per month)

Occupation	*Ownership* *Private*	 *Government*	 *Parastatal*
White collar	416	526	654
Managerial	416	1,098	1,782
Semitechnical	—	603	672
Clerks and typists	409	375	530
Skilled and semiskilled	277	312	349
Craftsmen	264	262	315
Drivers	327	329	385
Machine operators	232	310	308
Skilled workers	315	358	379
Unskilled	214	205	278
Messengers	216	208	243
Porters	293	213	270
Watchmen	200	188	302
Others	220	214	301
All occupations	263	396	409

— Not applicable.

Notes: Earnings are net of fringe benefits and represent the mean value for a given occupation/employer cell. The reported occupations had a minimum of eight employees per cell. In 1971 there were approximately 7 shillings to the U.S. dollar.

Source: For tables G-1 through G-8, 1971 National Urban Mobility, Employment, and Income Survey of Tanzania (NUMEIST).

Table G-2. *The Distribution of Formal Sector Employment, by Occupation and by Ownership Category, Tanzania 1971*
(percentage of all occupations)

Occupation	*Ownership* *Private*	 *Government*	 *Parastatal*
White collar	9.6	51.3	27.8
Skilled and semiskilled	46.9	24.2	37.5
Unskilled	43.5	24.5	34.7

ment such differences will generate wage differentials in equilibrium. But in a labor market such as Tanzania's, where wage-paying jobs are relatively scarce, it is unlikely that job attributes alone can account for all of the observed wage differences.

Another explanation for these differentials can be firmly rejected. Higher public sector earnings do not compensate for lower levels of

Table G-3. *Fringe Benefits, by Ownership Category, Tanzania 1971*

Benefit	*Percentage of workers who receive benefit*			
	Private	*Government*	*Parastatal*	*Total*
Food	4.6	0.5	4.0	3.1
Housing	4.8	6.4	23.2	12.4
Medical care	49.9	73.3	76.8	67.4
Transport	34.0	57.2	52.0	48.0

nonwage benefits. Our survey includes information on such nonwage benefits as food, housing, medical treatment, and transport. Table G-3 suggests that fringe benefits are generally more prevalent in the public sector.

Alternative hypotheses abound. The premium paid to public sector employees at the top of the occupational hierarchy could be a residue of the colonial wage structure. The relatively inferior wage position of the least-skilled government workers may reflect the resolution of a conflict between the government's employment goals and its fiscal constraints. The premiums paid by parastatals could reflect the sharing of rents accrued as a consequence of monopoly power in product markets. Since in Tanzania in 1971 many of the parastatals were recently nationalized multinationals, the differentials could be the residues of premiums once paid by foreign firms to secure the loyalty of employees or to avoid charges of exploitation. Of course, simply disaggregating mean wages by occupation does not by itself permit rejection of the hypothesis that wage differentials among ownership categories are a result of differences in labor force composition—for example, in levels of education or in employment experience. To examine this last hypothesis further, we use our multivariate analysis.

Table G-4 presents the mean values for workers in private, government, and parastatal establishments of the independent variables included in the earnings functions. Public sector employees have more education than those in the private sector, and within the public sector the proportion of postprimary leavers is higher in government. Public sector employees are somewhat older and have 50 percent more experience in their current job than do workers in the private sector.[4] Moreover, parastatal enterprises have a higher proportion of workers in the capital city. Standardizing for each of these differences in characteristics is likely to reduce the magnitude of differences in earnings among ownership categories.

Estimation of the wage function, $\ln W = f(\mathbf{X})$, for the sample as a whole yields the following results (standard errors are in parentheses):

Table G-4. *Characteristics of Workers, by Ownership Category, Tanzania 1971*

Characteristic	*Ownership*		
	Private	*Government*	*Parastatal*
Education (percent)			
None	17.8	13.2	22.3
Primary	75.9	58.1	57.8
Postprimary	6.3	28.7	19.9
Age (years)			
Mean	29	31	32
Standard deviation	(8.6)	(10.3)	(10.1)
Employment experience (years in present job)			
Mean	3.9	5.8	6.2
Standard deviation	(5.5)	(8.0)	(7.8)
Location (percentage in Dar es Salaam)	60.5	57.6	71.0

Note: The data are for African male employees only.

$$
\begin{array}{rlllll}
\text{(G-2)}\ \ln W = 4.758 & +\ 0.219E_1 & +\ 0.914E_2 & +\ 0.018L & -\ 0.00016L^2 \\
 & \ \ (0.036) & \ \ (0.045) & \ \ (0.003) & \ \ (0.00011) \\
 & +\ 0.012A & +\ 0.138D & +\ 0.068Go & +\ 0.194Pa \\
 & \ \ (0.002) & \ \ (0.027) & \ \ (0.034) & \ \ (0.032)
\end{array}
$$

$$N = 1{,}291, \quad \bar{R}^2 = 0.365$$

where E_1 = primary education, E_2 = postprimary education, L = employment experience, A = age, and D = employment in Dar es Salaam.

All of the coefficients except that on the squared experience variable, L^2, are significant. As expected, the coefficients on education, experience, and location in Dar es Salaam are positive and substantial and, for the education variables, are in the usual size order. The coefficients on the government and parastatal variables are significant and positive, but the government coefficient is only about one-third the size of the parastatal coefficient. Even after differences in education, employment experience, age, and location of work are standardized, therefore, government employees earn a premium of 7 percent in relation to private sector employees and parastatal workers a premium of 21 percent.[5]

These estimates of public-private differentials may be biased, however, because the dummy variables for ownership category permit differences only in the intercept terms of employer-specific earnings functions. In the section that follows we consider whether there are observable differences in the structure of earnings among ownership categories. Our exercises provide the basis for a refined measure of public-private differentials. The comparison of wage structures also provides insights into the reasons for these differentials and, in particular, into why workers in parastatals are the best paid.

Differences in Wage Structures

Are there statistically significant differences among employer categories in the level or structure of wages? Table G-5 presents the results of a series of Chow tests that enable us to answer that question affirmatively. Since none of the possible pairwise combinations produces an F-statistic below the critical value at the 95 percent confidence level, we can reject the hypothesis that observed differences in wage levels and structures among employer categories are simply the result of chance.

The stratified regressions in table G-5 suggest that most of the differences among categories are attributable to differences in constant terms (levels) rather than to differences in coefficients (structures). The coefficients on all but one independent variable are similar for the three owner-

Table G-5. *Earnings Functions, Stratified by Ownership Category, Tanzania 1971*

	Ownership		
Item	*Private*	*Government*	*Parastatals*
E_1	0.196	0.221	0.238
	(0.050)	(0.092)	(0.054)
E_2	0.874	0.914	0.948
	(0.088)	(0.102)	(0.067)
L	0.013	0.021	0.020
	(0.004)	(0.006)	(0.004)
L^2	0.0001	−0.0002	−0.0003
	(0.0002)	(0.0002)	(0.0002)
A	0.012	0.014	0.010
	(0.002)	(0.004)	(0.03)
D	0.250	0.015	0.151
	(0.039)	(0.057)	(0.045)
Constant	4.717	4.821	4.992
$\bar{R}^2$	0.306	0.303	0.351
N	410	384	497

Note: E_1, primary education; E_2, postprimary education (the omitted category being no education); L, employment experience; A, age; D, employment in Dar es Salaam. Figures in parentheses are standard errors. Chow tests on pairs of equations yielded F-values of 2.48 for the private-government comparison, 7.10 for the parastatal-government comparison, and 3.33 for the private-parastatal comparison.

ship categories. For example, when we control for differences in other characteristics, the estimated premium earned by secondary completers in relation to uneducated workers is 140 percent in private establishments, 149 percent in government establishments, and 158 percent in parastatal establishments. The location variable is the exception; whereas private firms pay a premium of 28 percent to workers employed in Dar es Salaam and parastatals a premium of 16 percent, the government's premium is only 1.5 percent.

In contrast to the similarity in coefficients, there are large differences in constant terms. The difference between the private and parastatal constants represents a wage premium for parastatal employees of 35 shillings, or 32 percent of private sector earnings. The constant in the government equation represents a smaller premium, 11 percent, in relation to the private sector.

The results of the stratified equations are only suggestive, since the comparison of coefficients across equations has not been subjected to tests of statistical significance. A fully interactive equation permits such tests. The addition of the interaction terms to the equation for the whole

Table G-6. *Earnings Function with Interactions among Ownership Categories and Other Independent Variables, Full Sample, Tanzania 1971*

		Coefficients on interactive variables with	
Item	*Coefficients on independent variables*	*Government*	*Parastatals*
E_1	0.196*	0.025	0.042
	(0.061)	(0.098)	(0.083)
E_2	0.874*	0.040	0.074
	(0.107)	(0.137)	(0.127)
L	0.013*	0.008	0.007
	(0.005)	(0.007)	(0.007)
L^2	0.0001	−0.0004	−0.0004
	(0.0003)	(0.0003)	(0.0003)
A	0.12*	0.002	−0.002
	(0.003)	(0.004)	(0.004)
D	0.250*	−0.236*	−0.100
	(0.048)	(0.068)	(0.066)
Constant	4.717	0.104	0.275*
		(0.173)	(0.153)
$\overline{R}^2$	0.369	—	—

— Not applicable.

*Significant at the 95 percent level.

Note: For definitions of variables, see note to table G-5. Figures in parentheses are standard errors. The sample number is 1,291.

sample is reported in table G-6, and the results confirm the impression conveyed by the stratified equations. The premium in government establishments—for example, that to primary education—is given by $bE_1 + b(Go \cdot E_1)$. Similarly, the premium to primary education in parastatals is given by $bE_1 + b(Pa \cdot E_1)$.

Not one of the interaction terms on primary education, postprimary education, employment experience, experience squared, or age is statistically significant. In these respects the wage structure in government and parastatal establishments in 1971 was similar to that in private establishments.

The two significant interactive terms are also notable. The premium for being located in Dar es Salaam was significantly less in government than in the private sector and was also less in parastatals but not significantly so. The results also confirm that, irrespective of personal characteristics, workers in parastatals received a premium in relation to workers in private and government establishments. The parastatal-constant interaction term is positive and statistically significant, whereas the government-constant interaction term is positive but insignificant.[6]

Several alternative hypotheses for the large premium earned by workers in parastatals were suggested above, and the results of the interactive equation favor one explanation in particular.

The first hypothesis is that the premium stems from differences among ownership categories in labor force composition. The large premium earned by parastatal employees survived our best attempts to standardize for such differences, but this does not necessarily imply that they have no role in explaining the remaining parastatal-private differential. Our measures of human capital, although comparable with those employed in other earnings functions, are still crude. Parastatals may be paying a premium to attract the very best candidates from among those of given levels of education and employment experience, a practice referred to as "creaming." In unskilled occupations, however, the productivity-augmenting effects of more human capital are undoubtedly much smaller than in skilled manual, technical, or white-collar occupations. This suggests that the incentives for parastatals to cream would increase with occupational level and that, correspondingly, the premium paid to attract the best candidates would be larger for workers with relatively high qualifications.

The second hypothesis—the monopoly rent hypothesis—predicts that the wage premium will be higher for the more educated and more experienced employees. If parastatal managers chose to distribute to employees rents earned in product markets, we would expect the wage premium to be higher among the best-qualified workers, who include within their ranks the very managers who make the distributional decisions.

Our third hypothesis is that the premium paid by parastatals is a residue of the price paid by former multinationals to obtain acceptance. If foreign firms did pay a premium to avoid charges of exploitation, we might expect the premium to be as large at the base of the occupational pyramid as at the pinnacle, or even larger. This prediction is the opposite of those yielded by the first two hypotheses. The estimated interactive regression indicates that, as a percentage, the premium paid by parastatals to workers with low qualifications is as great as the premium paid to highly qualified workers. The results therefore lend support to the third hypothesis.

The location variable is the exception to the generalization that the slopes of the earnings functions are constant across ownership categories. Privately owned establishments paid workers in Dar es Salaam substantially more than they did similarly qualified employees in other towns. Presumably this is because in the capital city the cost of living is higher or the labor market tighter. The government did not pay higher wages to workers in Dar es Salaam [$bD - c(D \cdot Go) \cong 0$], presumably because the centrally administered wage structure is insensitive to regional differences in the cost of living or in market conditions. The fact that parastatals also offered a Dar es Salaam wage premium may reflect a responsiveness to local labor demand conditions similar to that exhibited by private firms, which in turn may reflect the former multinational and private sector status of many of these enterprises.

Decomposition of Gross Wage Differences

The parameter β can be a misleading indicator of the magnitude of differences in wage levels among ownership categories when there are also differences in wage structures. Although we have shown the structural differences to be small, our best estimate of differences in levels should nevertheless incorporate them. Tables G-7 and G-8 summarize the results of the simulation exercise for representative private, government, and parastatal employees (those with the mean characteristics of all workers in their ownership category). These allow us to decompose gross wage

Table G-7. *Gross Wage Differences among Ownership Categories, Tanzania 1971*

Item	*Government-private*	*Parastatal-private*	*Parastatal-government*
Gross wage difference			
Shillings a month (G)	396 − 263 = 133	409 − 263 = 146	409 − 396 = 13
Percent (α)	51	56	3
Standardized wage difference			
Percent	7	21	14

Note: G, α, and β are defined at the beginning of this appendix.

Table G-8. *Contribution to Gross Wage Differences of Differences in Labor Force Composition among Ownership Categories, Tanzania 1971*

Contribution as percentage of G	*Government-private*		*Parastatal-private*		*Parastatal-government*	
	$f(\mathbf{X}_{Pr})$	$f(\mathbf{X}_{Go})$	$f(\mathbf{X}_{Pr})$	$f(\mathbf{X}_{Pa})$	$f(\mathbf{X}_{Go})$	$f(\mathbf{X}_{Pa})$
Education ($E_1 + E_2$)	58.4	60.2	23.6	24.2	−101.4	−105.1
Experience ($L + L^2$)	9.8	1.1	8.4	11.0	−2.5	8.8
Age (A)	8.7	10.2	10.1	8.4	17.5	12.5
Location (D)	−2.5	−0.1	7.3	4.5	2.5	25.0
Total explained (E)	74.4	71.4	49.4	48.1	−83.9	−58.8
Residual (R)	25.6	28.6	50.6	51.9	183.9	158.8
Wage difference after accounting for differences in characteristics (shillings a month)	34.0	37.9	72.8	75.8	23.8	20.6

Note: G is defined at the beginning of this appendix.

differentials into *E*, the component explained by various differences in characteristics, and *R*, the residual that stems from differences in earnings functions.

Government employees earned, on average, 51 percent more than private sector employees (table G-7), and the first two columns of table G-8 indicate that differences in characteristics account for roughly 73 percent of this large differential. The much higher educational attainment of our representative government employee—a reflection of the greater white-collar intensity of labor demand in the government than in the private sector—accounts for fully 85 percent of *E*. After differences in characteristics are taken into account the representative government worker earns about 36 shillings a month (13 percent) more than his private sector counterpart.

The gross wage difference in mean wages between private and parastatal employees (146 shillings, or 56 percent) is even larger than the government-private difference. In this case, however, a markedly smaller proportion, roughly half, is explained by differences in characteristics. Differences in educational attainment contribute the most to *E*, followed in descending order of importance by the greater experience and age of parastatal workers and their greater concentration in the capital city. The residual, *R*, which implies a difference of about 75 shillings a month, or 29 percent, is the premium our representative worker earns simply for being a parastatal rather than a private sector employee.

Since differences in characteristics explain more of the government-private differential than of the parastatal-private differential in mean wages, we would expect differences in characteristics to explain the small advantage in mean wages of the "typical" parastatal worker in relation to government workers. In fact, this small advantage is greater than is explained by differences in characteristics. The proportion of employees who were high-paid white-collar workers was nearly twice as high in the government as in the parastatal sector. As a corollary, government workers had a higher level of educational attainment. If government employees were paid according to the parastatal wage structure, they would actually have earned more, on average, than parastatal employees. This is indicated by the negative sign of the estimated total contribution to the gross wage difference of differences in composition, *E*.

Conclusion

Our analysis of public-private earnings differentials in urban Tanzania in 1971 suggests that worker characteristics cannot account for all of the differences in earnings between the public and private sectors of the wage economy. Both government and parastatal employees were paid more than the wage rates prevailing in the private sector. Public sector employers did not appear to be acting simply as wage takers. The government paid a modest premium, whereas parastatal workers earned 20 percent more than private sector workers with the same characteristics. A definitive test of competing hypotheses was not possible owing to the crudeness of our human capital measures and our inability to control for job attributes and hours worked. Nonetheless, the evidence suggests that the large parastatal premium was a residue of the premium paid by multinational firms before nationalization.

Notes

1. Wage earners include employees of all firms, regardless of size.

2. Private firms accounted for 31.8 percent, government for 29.7 percent, and parastatals for 38.5 percent of all urban wage employment. These proportions correspond well to the distribution of employment by firm type reported in the official *Survey of Employment and Earnings* in 1971.

3. The available data are for earnings per month. In the absence of information on hourly wage rates, we cannot reject the hypothesis that observed earnings differentials are attributable to differences in number of hours worked. We have no a priori reason, however, to expect hours worked to be related to ownership.

4. For most employees the current job is their first job, and the experience variable captures their total employment experience. The age variable is included to capture the effects on earnings of prior employment experience of workers who have had more than one job and of pure age effects.

5. Consistent and unbiased coefficients on the ownership category variables require that mobility among sectors not be a function of individual earnings, other things being equal. If interemployer mobility is a function of earnings, a simultaneous model of both earnings and sector of employment would be required to test for the independent effect of ownership category on wages.

6. The finding that most of the difference among ownership categories is in the constant terms rather than in the slopes of the earnings functions is further supported when this equation is compared with a restricted specification in which only the intercept and regional parameters are entered interactively. The *F*-test rejects the hypothesis that the addition of the other interactive terms adds to the explanatory power of the model.

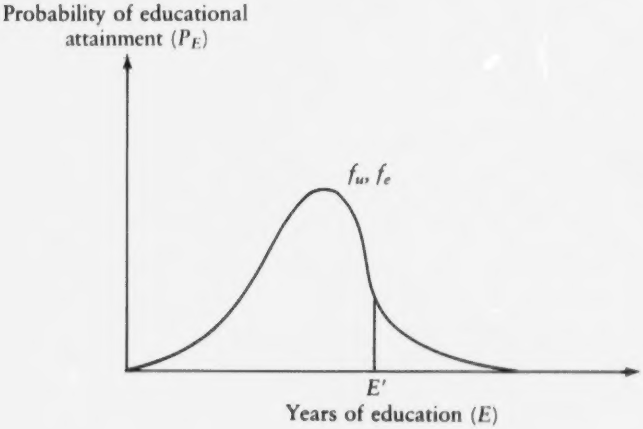
APPENDIX H

The Probability of Educational Attainment and Sample Selection Bias

THE IDEAL SAMPLE for the analysis of the determinants of educational attainment would be a random sample of the entire population. The most important difference between such a sample and our sample of urban wage employees is that the mean level of educational attainment of the latter will exceed that of the former. Rural-urban migration is selective of the more educated rural residents, and wage employment is selective of the more educated urban residents. Our interest lies in whether family background is associated with differences in educational attainment. Does the selectivity of our sample bias the results, and, if so, in what direction?

Assume initially that among individuals with the same educational

Figure H-1. *No Relationship between Family Background and Educational Attainment*



level the probability of being in the urban wage sector does not differ by family background (we call this the neutral assumption). In figures H-1, H-2, and H-3 we show P_E, the probability of attaining level of education E, and two probability distributions that correspond to f_e and f_u, educated and uneducated family backgrounds. Consider three possible cases regarding the relationship between family background and educational attainment in the entire population.

- There is no relationship (figure H-1). In this case f_e and f_u coincide. Those to the right of E' are in the urban wage sector from which our sample is drawn. As there is no relationship between family background and educational attainment in the total population, there will be no relationship in our sample.
- There is a strong positive relationship (figure H-2). In this case we observe in the sample (which again includes those to the right of E') a positive relationship between educational attainment and family background, but the observed relationship is weaker than in the population as a whole. The sample mean and the population mean for children of educated parents are quite close. The sample mean for children of uneducated parents, however, is substantially above the population mean for uneducated children. Therefore $\bar{E}'_{fe} - \bar{E}'_{fu} < \bar{E}_{fe} - \bar{E}_{fu}$.
- There is a negative relationship (figure H-3). In this case, the converse of that shown in figure H-2, we observe a negative relationship

Figure H-2. *Strong Positive Relationship between Family Background and Educational Attainment*

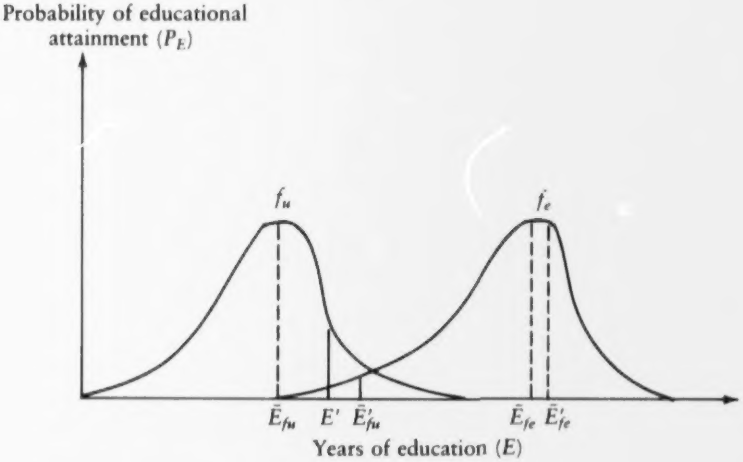
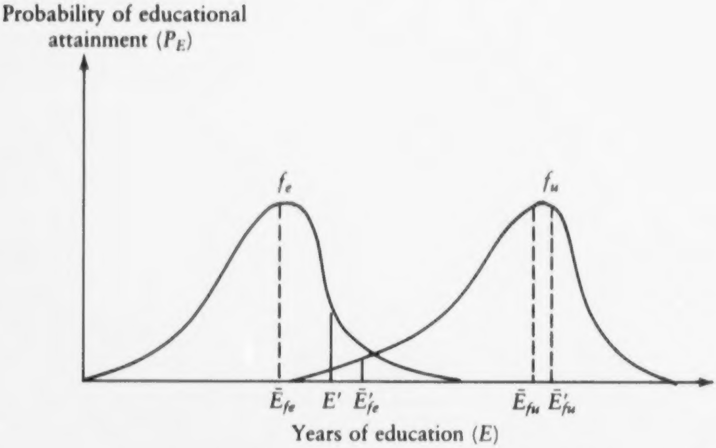


Figure H-3. *Negative Relationship between Family Background and Educational Attainment*



that is weaker than the true one; that is, $|\bar{E}'_{fe} - \bar{E}'_{fu}| < |\bar{E}_{fe} - \bar{E}_{fu}|$.

Now consider the effect of relaxing the assumption of neutrality. It is plausible that among individuals with the same education, those from relatively privileged backgrounds are more likely than their less privileged peers to be in the urban wage sector. If this effect is strong enough, we might observe a negative relationship in our sample when in the population there is no relationship or a positive one. If the true relationship is negative, we would observe a stronger negative relationship than the true one.

Our discussion is summarized in the following table.

	Relation observed in urban wage sample	
True relation in population	*With neutrality assumption*	*With neutrality assumption relaxed*
No relation	No relation	Negative relation
Positive	Weaker positive	Weaker positive, none, or negative
Negative	Weaker negative	Stronger negative

We have observed a strong positive relationship between family background and educational attainment in both the Kenyan and the Tanzanian samples. Our reasoning implies that the strength of these relationships in the samples underestimates their strength in the population as a whole. The use of a sample of the entire population or the correction of our urban sample for bias owing to sample selectivity would only reinforce our findings. Far from weakening our sample finding of a positive relationship between educational attainment and family background, sample selection bias implies that the finding is even stronger for the population as a whole.

APPENDIX I

Family Background and the Returns to Schooling

IN TANZANIA WE FOUND no independent influence of family background on earnings of form 4 leavers, and the relationship that we found in Kenya was largely attributable to discrimination. These results should not mislead us into thinking that family background has little or no influence on returns to schooling. Our model suggests that the influence of family background was not noticeable at the secondary level in Tanzania because of the highly selective nature of the secondary school system, which gave access only to the upper tail of the distribution of primary leavers from uneducated backgrounds. In Kenya the measured human capital effect of family background was attenuated by the high rate of promotion to higher education of those from more educated backgrounds.

Here we switch from examining the relationship between family background and earnings at a particular educational level to examining the effect of family background on the returns to schooling for all workers in our sample. We have noted various ways in which family background can affect earnings: children of educated parents tend to receive more out-of-school investment in human capital, which may result in their learning more at school; they tend to go to higher-quality schools; and they may benefit from discrimination in the labor market.

Insofar as labor market discrimination favors the children of educated parents, we would expect the effect on earnings to be the same irrespective of the educational level of the worker. Similarly, out-of-school investment, to the extent that it raises earnings directly, should do so irrespective of educational level. In both cases the returns to education should not be affected by family background. The returns would be raised, however, if the higher-quality schooling received by children from educated

Note: Adapted from Jane Armitage and Richard H. Sabot, "Socioeconomic Background and the Returns to Education in Two Low-Income Countries," *Economica* 54, no. 213 (February 1987): 103–08.

backgrounds raised the value added of a year of schooling or if out-of-school investments were complementary with human capital accumulation in school, thus increasing the amount learned during a school year. A comparison of the returns to years of schooling among family background groups should therefore serve as a pointer to the reasons for the influence of family background.

Empirical Results

The earnings function we estimate is of the general form:[1]

$$W = f(\mathbf{Z}, F_j) \tag{I-1}$$

where $\mathbf{Z}$ = a vector of human capital variables made up of S, years of education, and L and L^2 = years of employment experience and their square; F_j = dummy variables that denote family background, and W = ln earnings. In equation I-1 the returns to schooling are constrained to be the same for all family background groups. We also estimate the following unconstrained equation:

$$W = f(\mathbf{Z}, F_j, \mathbf{Z} \cdot F_j) \tag{I-2}$$

where $\mathbf{Z} \cdot F_j$ are interaction terms that measure the returns to human capital for workers whose parents have various levels of education in relation to returns for workers with uneducated parents.[2] F-tests are conducted on equations I-1 and I-2 to determine whether the observed differences are statistically significant.

Tables I-1 and I-2 present the estimates of the constrained and unconstrained earnings functions, respectively. For Kenya the value of the F-statistic is 7.5 and for Tanzania it is 5.2; both exceed the critical value of F at the 1-percent significance level. Therefore for both Kenya and Tanzania we reject the null hypothesis that returns to human capital are independent of family background. The t-statistics pertaining to the coefficients on the family background variables also suggest that the unconstrained equation is the superior specification; nearly all are highly significant. The education and experience variables are highly significant in both sets of equations.

In table I-2 the average earnings premium per year of schooling for workers with uneducated parents is the coefficient of S; for workers from other family background groups the premium is the coefficient of S plus the coefficient of $S \cdot F_j$. The results indicate that in both countries returns to education rise sharply with the socioeconomic status of the workers' parents. In Kenya the wage premium per year of education is 8.5 percent for workers in the F_1 group (uneducated parents), 11.0 percent for workers in the F_2 group (one parent with no education, the other with primary education), and between 15.6 and 16.7 percent for workers in the top

Table I-1. *Constrained Earnings Functions*

	Coefficient	
Variable	*Kenya*	*Tanzania*
S	0.101	0.078
	(23.33)	(25.38)
L	0.54	0.57
	(13.38)	(14.90)
L^2	−0.001	−0.001
	(7.44)	(6.84)
F_2	0.030	−0.002
	(0.92)	(0.08)
F_3	0.141	0.027
	(3.78)	(0.89)
F_4	0.360	0.036
	(4.80)	(0.61)
Constant	5.519	5.607
$\bar{R}^2$	0.354	0.431
N	1,600	1,522

Note: S, secondary education; L, employment experience; F_2, one parent with primary education and one with none; F_3, both parents with primary education or one with secondary or higher and one with none; F_4, one parent with primary education and one with secondary or higher or both with secondary education or higher; (F_1, both parents without education, is the omitted category). The dependent variable is ln W. Figures in parentheses are t-statistics.

two groups. Similarly, in Tanzania the premium is 6.7 percent for workers with uneducated parents, 8.6 percent for workers in the F_2 category, and between 9.6 and 10.3 percent for workers with the most highly educated parents.

Interpretation of Results

The educational production function describes the relationship between the output of the skill acquisition process and such inputs as quantity of schooling, quality of schooling, individual ability, and out-of-school investments in human capital as proxied by family background (see Hanushek 1979 and Lau 1979). In a human capital theoretic framework, wages depend on the output of this process (the individual's stock of cognitive and other skills), not simply on years of schooling, which is just one of the inputs. There may be an interaction in the educational production function between out-of-school investments and formal schooling. If these two inputs are complements, the returns to schooling will increase with family background in the earnings function. Conversely, if

Table I-2. *Unconstrained Earnings Functions*

Variable	*Coefficient*	*Interaction terms*		
		F_2	F_3	F_4
Kenya (N = 1,600)				
S	0.085	0.025	0.071	0.082
	(16.11)	(2.30)	(5.44)	(2.77)
L	0.044	0.032	0.025	0.106
	(8.67)	(2.69)	(2.03)	(2.81)
L^2	−0.002	−0.001	0.0001	−0.004
	(5.10)	(2.27)	(0.20)	(2.25)
Constant	5.724	−0.341	−0.756	−0.952
$\bar{R}^2$	0.375	3.40	3.24	2.89
Tanzania (N = 1,522)				
S	0.067	0.019	0.036	0.029
	(17.19)	(2.48)	(3.93)	(1.25)
L	0.041	0.022	0.033	0.073
	(7.98)	(2.27)	(3.26)	(3.08)
L^2	−0.001	−0.001	−0.001	−0.003
	(2.98)	(1.54)	(1.96)	(2.97)
Constant	5.774	−0.269	−0.460	−0.525
		(3.29)	(4.93)	(1.99)
$\bar{R}^2$	0.445	—	—	—

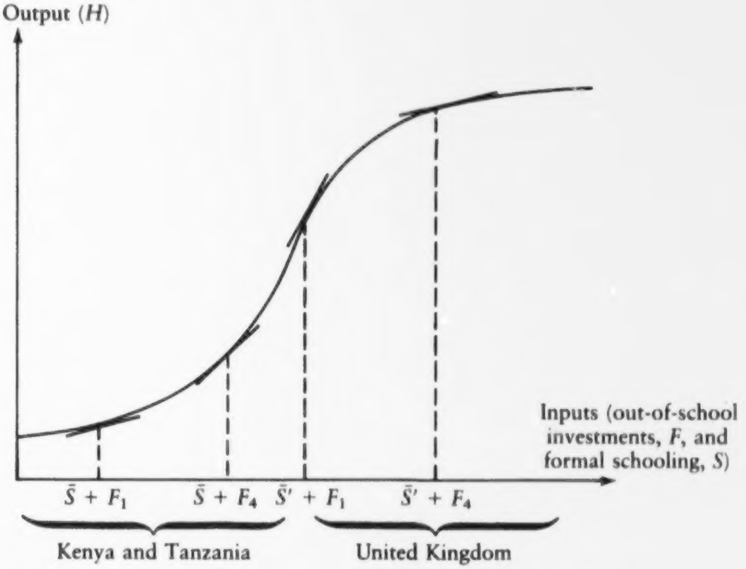
— Not applicable.

Note: For definitions of variables, see note to table I-1. The dependent variable is ln W. Figures in parentheses are t-statistics.

out-of-school investments and formal schooling are substitutes and the educational production function exhibits diminishing returns, the returns to schooling in the earnings function will decrease with family background. An explanation, therefore, for the positive relationship between family background and the returns to schooling in Kenya and Tanzania is that out-of-school investments and formal schooling are complementary. Suppose that the relationship between the output and inputs (supplied at home or in school) of the skill acquisition process is S-shaped, as in figure I-1; that is, there are increasing returns at low levels of inputs and decreasing returns at high levels of inputs. Kenya and Tanzania, which have low levels of educational inputs, may be in the phase of increasing returns: for a given input of formal schooling (S), the greater out-of-school investments associated with higher socioeconomic status (F_4 rather than F_1) raise the output of cognitive skill (H) per unit of input.

The returns to experience also increase with socioeconomic back-

Figure I-1. *Acquisition of Cognitive Skill*



ground. This may be because well-placed parents are able to pull strings to get their children into jobs with more promotion potential and more opportunities for on-the-job training. Alternatively, those from more privileged backgrounds may have lower discount rates which induce them to invest in more on-the-job training. It was noted in chapter 4, however, that returns to experience increase with education. If the higher returns to experience of those from more privileged backgrounds are attributable to their higher levels of human capital, taking account of this would strengthen the positive relationship found in Kenya and Tanzania.

The tendency for the coefficient on years of schooling to rise with parental education in Kenya and Tanzania contrasts with results obtained from a similar exercise for the United Kingdom. Papanicolau and Psacharopoulos (1979) examined the relationship between family background and private returns to schooling in the United Kingdom with the use of data on wage employees from the General Household Survey of 1972. They found that returns fall as the status of the worker's father rises. The authors suggest that in the United Kingdom decreasing returns have set in. Figure I-1 shows the United Kingdom, with its much higher level of educational inputs per student, on the concave part of the educational production function where increases in inputs reduce outputs per unit of input.

An alternative explanation for the difference between the United Kingdom and Kenya and Tanzania lies in the labor market—in the wage determination process, rather than in the process of skill acquisition. Papanicolau and Psacharopoulos suggest that British students from privileged backgrounds may obtain good jobs regardless of their level of skills. In Kenya and Tanzania, where socioeconomic differentiation is a more recent phenomenon, such a floor under the earnings of the children of the relatively privileged may not exist. Another explanation for the British pattern is that ability and education are substitutes in the determination of earnings and that there is a positive correlation between ability and family background. Again, we would not expect to find the same pattern in Kenya and Tanzania, where socioeconomic differentiation is so recent.

In conclusion, the fact that in both Kenya and Tanzania the coefficient on years of schooling rises with parental education suggests that family background influences earnings because complementarity between out-of-school and school investments in human capital enables the children of the educated to learn more in school or because these children attend better-quality schools. It suggests that less importance is to be placed on the independent effect of human capital acquired out of school or on the effect of labor market discrimination.

Notes

1. It is common for the earnings function to include measures of noneconomic personal characteristics that might nevertheless have an influence on earnings, such as race or sex. Another study using these data sets found evidence of race discrimination but not of discrimination on the basis of sex (Armitage and Sabot forthcoming a). We therefore focus our analysis on Africans, who constitute over 90 percent of the urban wage labor force in both Kenya and Tanzania, and we do not include a dummy variable for sex.

2. The unconstrained earnings function is equivalent to estimating four regressions, one for each family background group. The earnings function for the base group ($F_1 = 1$) is given by the first column of coefficients in table I-2. To obtain the earnings function for the F_2 category we add the coefficients in the first and second columns and similarly for the F_3 and F_4 categories.

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Developing countries spend tens of billions of dollars each year on education. In the face of severe competition for scarce resources, the effectiveness and distribution of these expenditures merit careful examination. The need for universal primary education is no longer questioned: the key policy issue is at the secondary level. Does expanding the secondary system make good economic sense for a developing country? Do better-educated workers contribute to economic development, or are they merely being trained for minimal jobs that will waste their skills? Does educational expansion increase the inequality of income by adding to the number of well-paid workers or decrease it by reducing the earnings premium that education can command? Does reducing inequality of access to secondary education increase intergenerational mobility? In this book John B. Knight and Richard H. Sabot seek to answer these and other questions.

Isolation of cause and effect in social processes is hampered by the large number of cultural and economic variables that can cloud the effects of any one factor. In East Africa, however, a "natural experiment" is ready to hand. Kenya and Tanzania are similar in many ways--in size, colonial background, natural resources, and economic structure. But because of divergent education policies, secondary enrollment is much higher in Kenya than in Tanzania.

To investigate how differences in the availability of secondary education in Kenya and Tanzania have influenced productivity, Knight and Sabot and their colleagues gathered information on urban workers and pioneered tests of cognitive skill and reasoning ability. This innovative approach enabled them to isolate the different paths by which education affects earnings and their distribution. Their findings have wide implications, touching on the operation of the labor market, the interpretation of the education-earning relationship, the allocation of educational resources, the costs and benefits of subsidies, and the effects of secondary schooling on economic and social mobility and on income distribution.

A companion volume, *Education, Work, and Pay in East Africa*, by Arthur Hazlewood, Jane Armitage, Albert Berry, John Knight, and Richard Sabot has been published by Clarendon Press.

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